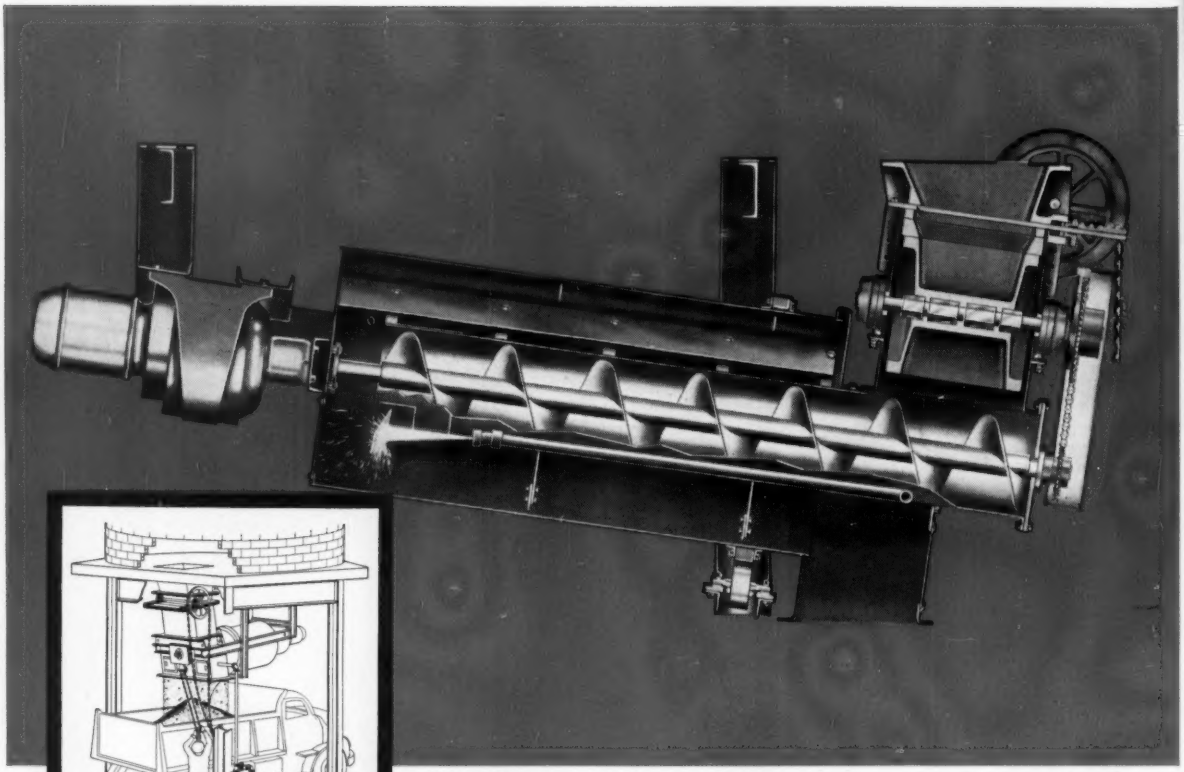
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES • A McGRAW-HILL PUBLICATION

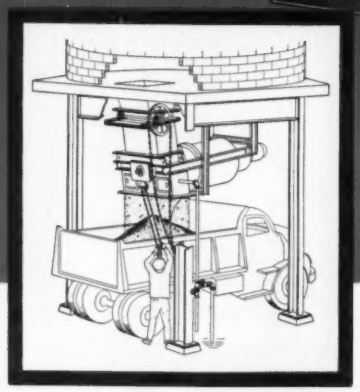
Power

JULY 1956•50¢

For the plant-service engineer

How to sell a better lubrication program . . . 96
Should plant engineers get a PE license? . . . 107
Easy maintenance of split-case feed pumps 110
Motor insulation-testing can pay off 118





Operator controls unit from the ground.

Dry material enters the lower end of the unit through a rotary feeder and is carried by screw conveyor to the higher end. Here, a single jet of water wets the material as it enters the mixing drum. The material is then mixed and agitated in the rotating drum, conveyed downward toward the lower end of the unit and discharged.

NEW A-S-H MIXER-UNLOADER

minimizes dust nuisance in transporting ash

The removal of ash from storage bins can be a dust-free operation with the new Allen-Sherman-Hoff Type B Continuous Mixer and Unloader.

Installed under the bin, the combination unit continuously mixes ashes with water and discharges the properly moistened mixture to trucks or rail cars.

Efficient Design. Control is from the ground rather than from a raised platform. Operator observes discharge and adjusts conveniently located water and feed controls to secure desired consistency.

A single large water nozzle assures highest efficiency. Weatherproof construction eliminates need for an enclosure. Direct-connected drive rotates both drum and screw feeder at same time. This eliminates ring gear on mixing drum and the sealing problem between drum and feed section.

Trouble-Free Operation. Unit will operate for long periods without attention. All bearings are anti-friction type. Single large-orifice water nozzle is less subject to plugging than smaller types.

Economy of Installation. Unloader is suspended from the base of the storage bin. No platform is required. In addition, the shorter overall height of the unit means a saving in column lengths.

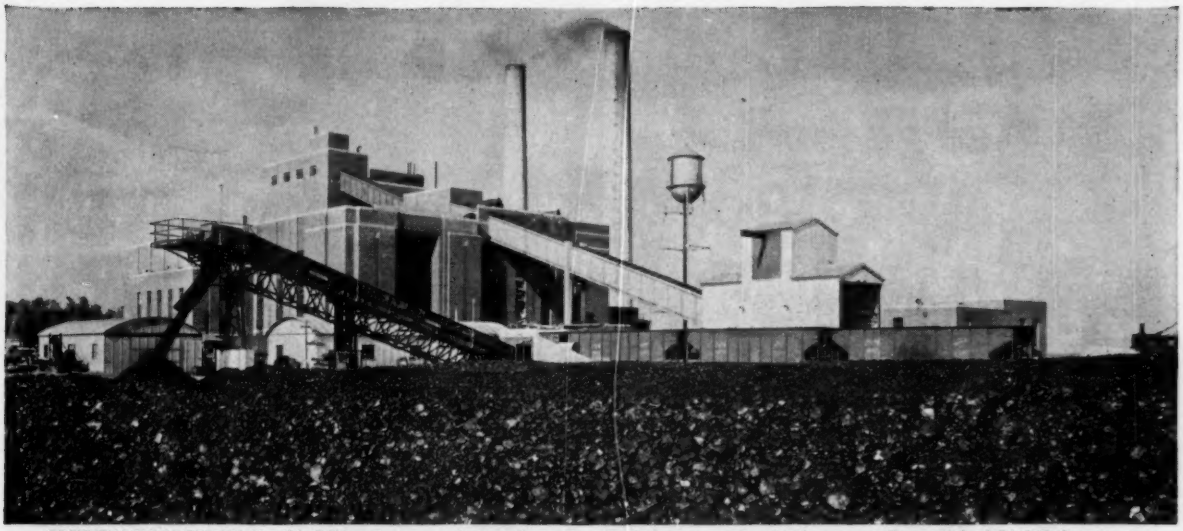
Ease of Maintenance. Unloader is a self-contained unit that is easily lowered by hoist for maintenance and overhaul.

For complete technical information on the A-S-H Type B Continuous Mixer and Unloader, write for your copy of Data Sheet Uc.

The **Allen-Sherman-Hoff** Company

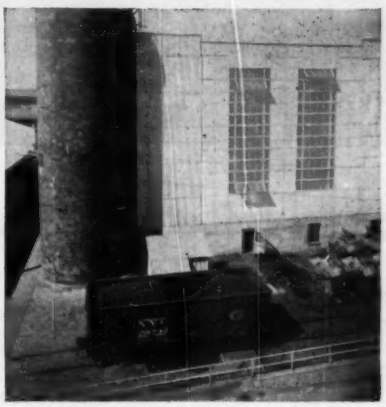
259 E. Lancaster Ave., Wynnewood, Pa.
Offices and Representatives in Principal Cities

MATERIALS HANDLING SYSTEMS
hydrojet *hydraulic* / **hydrovac** *pneumatic*



RECENTLY ENLARGED BY ⅔, this Midwest power plant underwent minimum rearrangement. Coal distribution equipment was extended to serve new bunkers as well as original Link-Belt system installed in 1931. Stacker in yard piles 30,000-ton reserve.

12-HOUR CHANGEOVER to fuel two additional generating units was accomplished in revamping this coal handling system.



SMALL PLANTS restricted in area get expandability plus efficient utilization of initial equipment from Link-Belt designs.

BOOK 2410 has complete data on Link-Belt coal handling equipment plus tested layouts of large and small systems.

Coal handling has room to grow

when Link-Belt provides for low-cost expansion of capacity in both large power plants and small boiler houses

THE growth of populations and industry usually demands provision for coal handling expansion in the initial plans of power stations and boiler houses. Link-Belt has helped meet that need, with consideration for location, transportation facilities, reserve storage needs and other special problems.

With its broad line of equipment, Link-Belt offers a single source for feeders, elevators, conveyors, stackers—whatever you need for lowest per-ton handling costs. In addition, Link-Belt engineering can adapt the lessons taught by thousands of installations to your individual requirements.

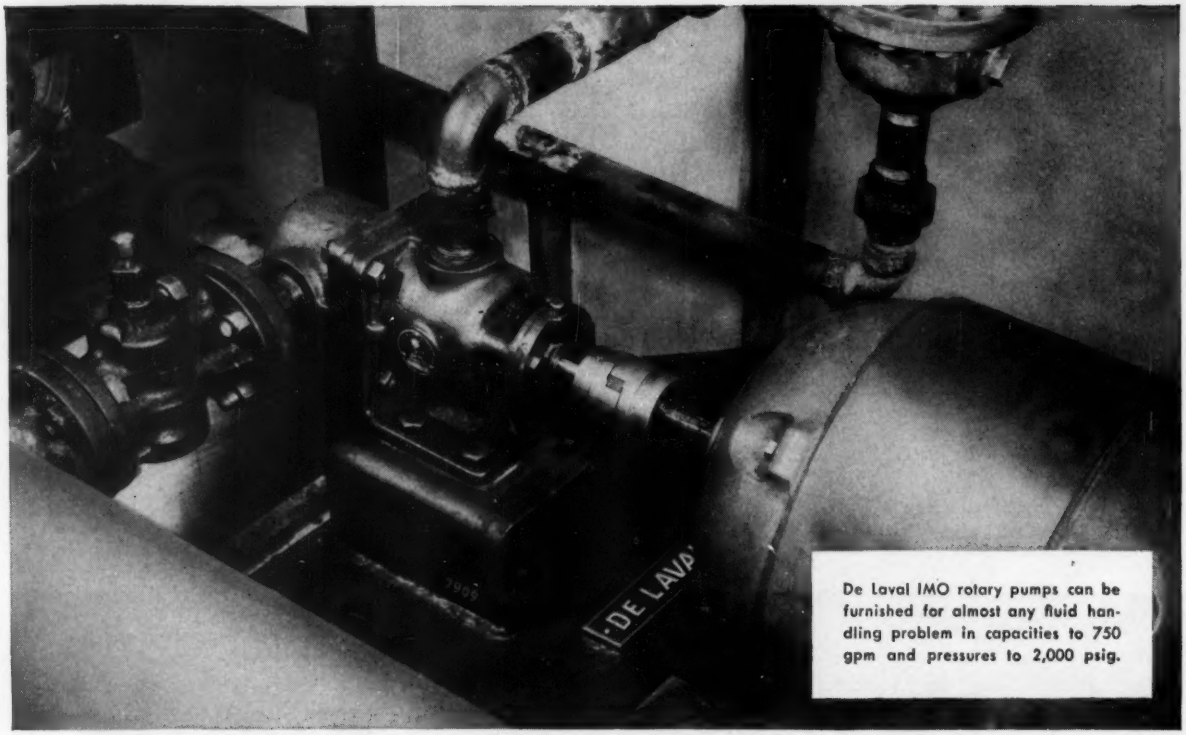
Working with your consultants, Link-Belt is equipped to accept full responsibility for design, fabrication, erection and satisfactory performance of your entire system. Or, if you need only a single conveyor, call your nearest Link-Belt office for prompt, expert service.

14,097

LINK-BELT

COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



De Laval IMO rotary pumps can be furnished for almost any fluid handling problem in capacities to 750 gpm and pressures to 2,000 psig.

What to Look for in a Rotary Screw Type Pump

By W. J. MONCON, *Assistant Chief Engineer*
De Laval Steam Turbine Company

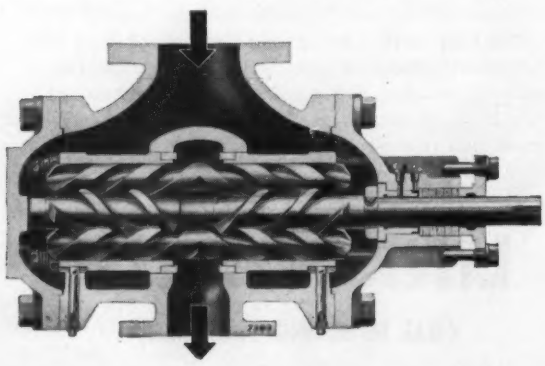
A sound knowledge of design, and how it affects performance, is the best insurance a buyer can have that he will get the pump he needs. This brief analysis of the IMO, a rotary three-screw pump manufactured by the De Laval Steam Turbine Company, will give you some of the necessary facts.

What qualities should you look for in a rotary type pump? It must, of course, meet specified capacities and pressures. But, it must also be efficient, operate quietly, stay on the job.

The axial flow of a screw type pump, and the resulting low inlet losses for any given pump speed, are important benefits that should be considered in making pump selections. The absence of timing gears and other mechanical features of construction also enable the De Laval IMO pump to operate at direct-connected motor and turbine speeds . . . to handle viscous liquids and high suction lifts.

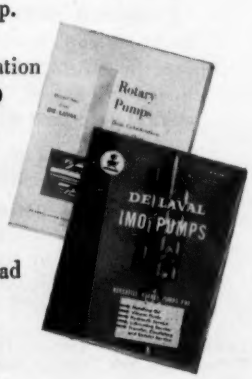
One of the most important features of the IMO pump is the hydraulic turning of the idler or sealing rotors. The central or power rotor is the pumping element; the liquid pumped turns the sealing rotors.

A screw type pump is well suited for applications where pulsation-free flow is desirable. The axial flow of the liquid without trapping and the unique thread form which keeps closures fluid-tight contribute to quiet operation of the IMO pump.



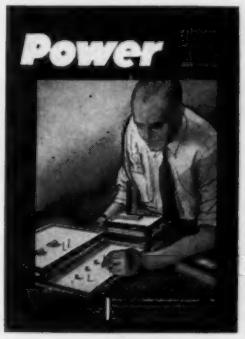
This is a cross-section of the De Laval IMO Series A322A, a positive displacement rotary screw type pump.

Catalog LS gives useful application and specification data on the IMO pump. An article titled, *Rotary Pumps, Basic Considerations in Their Application,* contains a description of rotary pumps in general. For these publications, write on your company letterhead to De Laval Steam Turbine Company, 815 Nottingham Way, Trenton 2, New Jersey. DL-301



Power

JULY 1956 • VOLUME 100 NUMBER 7



ENGINEERING AND MANAGEMENT

Modernizing air-conditioning on Capitol Hill ____ 75
New power-plant idea—feedwater heating towers ____ 80
Internal water treatment and blowdown keep boiler clean ____ 84
Now, fluidized firing of cheap fuel ____ 86
4-point program for power-service economy: Part 2 ____ 89
Designing a 190-mw nuclear power plant: Nuclear study course 92
Tips on selling a better lube plan ____ 96
Welding chrome-moly alloy-steel piping ____ 98
Data sheet: Choosing pipe sizes for water systems ____ 103

PLANT OPERATION AND MAINTENANCE

Should you get your Professional Engineer's license? ____ 107
Operate, troubleshoot, repair a split-case h-p feed pump ____ 110
Diesel starting systems ____ 116
When motor insulation-resistance tests pay off ____ 118
Final checks and adjustments on refrigeration systems ____ 120
Using ac ammeters for plant maintenance ____ 122
Practical ideas ____ 124
Plant problems ____ 130
Arguments ____ 136
How-to ____ 138
Fluid facts: No 11 in a series 140
Marmaduke Surfaceblow ____ 142

READER SERVICE SECTION

This month's service features 146
Reports from the field ____ 148
Technical briefs ____ 150
Plant equipment news ____ 154
New free literature ____ 163
George Edwards ____ 166

Print order this issue: 48,385

THE PLANT-SERVICE ENGINEER continues to assume a bigger chunk of his plant's overall engineering responsibilities. Producing steam and distributing electricity are still a prime concern—but that's just part of his job. This month, articles on lubrication, PE licenses, feed pump maintenance, motor insulation-testing, outline typical problems power men face today.

Next month . . .

Automation, with its rapid industrial growth, has triggered a demand for variable speeds, precise motor control. Motor manufacturers meet this need with "packaged variable-speed drives." August article pins down current maintenance thinking to serve as your guide.

Residual diesel fuel can play hob with an engine's innards. This 2-pager gives results you can expect when one popular type of fuel-oil additive is put to work solving the problem.

Basics series switches its theme to *Electricity* for some time to come. Next month's article explains electric current, how it flows in a conductor.

Refrigeration systems have a Number One enemy—moisture. Easy to get in, hard to get out, it causes more headaches than any other single thing. Coming article sheds light on how to deal with plagued systems, get results.

. . . and future months

12,000-hp feed pump, world's largest, will be driven direct from main generator steam turbine. Fluid drive and pump of this unique setup will be covered in a forthcoming article.

JULY 1956 POWER Vol. 100—No. 7

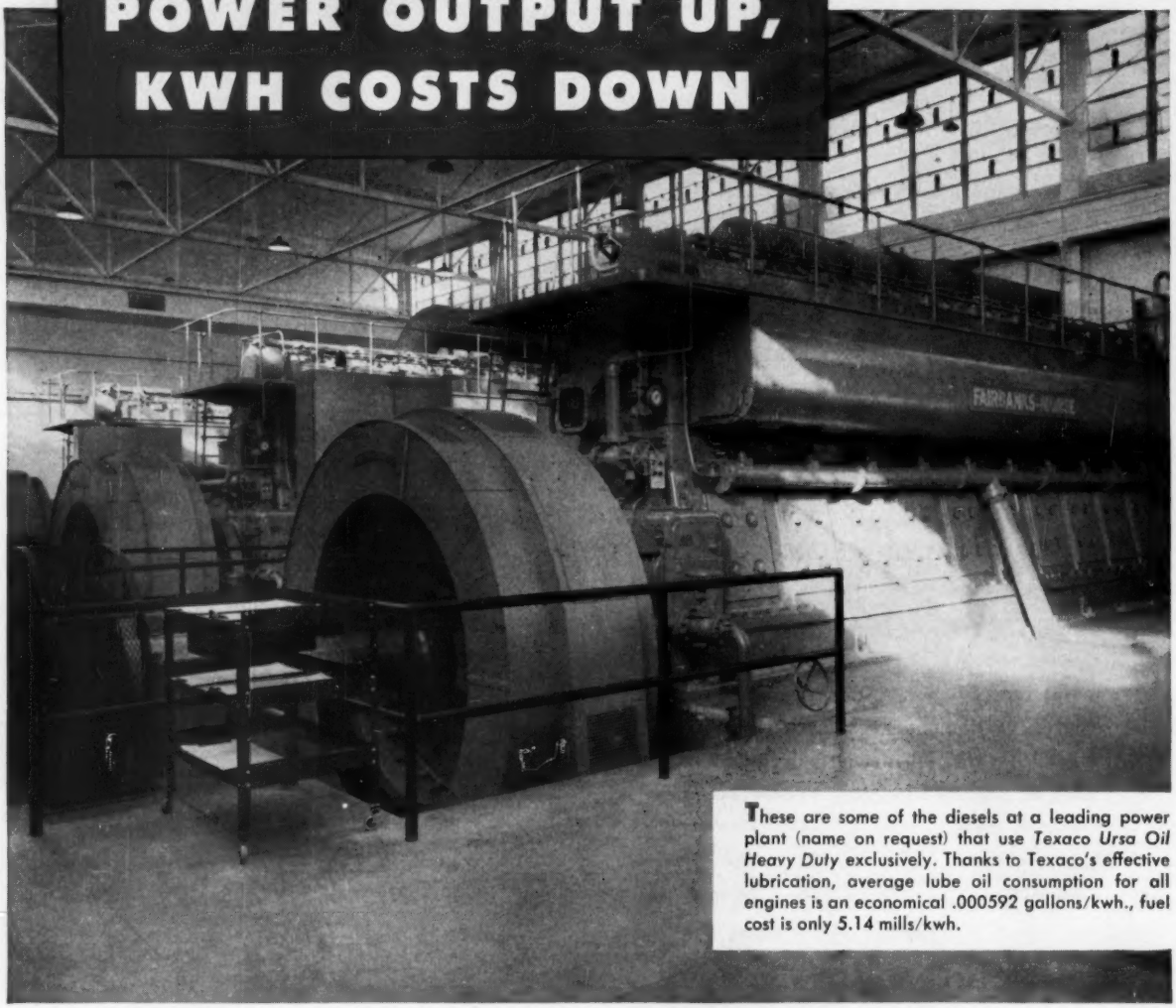
POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly with an additional Handbook statistical number in September, by McGraw-Hill Publishing Company, Inc. James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W. 42nd St., New York 36, N. Y.

EXECUTIVE, EDITORIAL and ADVERTISING OFFICES: 330 W. 42nd St., New York 36, N. Y. Donald C McGraw, President; Paul Montgomery, Executive Vice-President; Joseph A Gerardi, Vice-President and Treasurer; John J Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B Smith, Vice-President and Editorial Director; Joseph H Allen, Vice-President and Director of Advertising Sales; J E Blackburn Jr, Vice-President and Director of Circulation.

SUBSCRIPTIONS: Address correspondence to POWER, Subscription Service, 330 W. 42nd St., New York 36, N. Y. Allow one month for change of address. Subscriptions are solicited only from executives, engineers and supervisory personnel engaged in design, operation and maintenance of power, light, heat and other plant services in utilities, construction firms, industrial and service plants. Position and company connection must be indicated on subscription orders.

Single copies: U. S. and possessions, Canada 50¢ (except mid-September Handbook $1.00); all other countries $1.50. Subscription rates—U. S. and U. S. possessions: $4.00 for one year, $6.00 for two years, $8.00 for three years. Canada: $6.00 for one year, $9.00 for two years, $12.00 for three years. All other countries: $15.00 for one year, $25.00 for two years, $30.00 for three years. Second-class mail privileges authorized at New York, N. Y. Printed in U. S. A.
Copyright 1956 by McGraw-Hill Publishing Company, Inc. All rights reserved.
POWER articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index.

HOW YOU CAN KEEP POWER OUTPUT UP, KWH COSTS DOWN



These are some of the diesels at a leading power plant (name on request) that use *Texaco Ursa Oil Heavy Duty* exclusively. Thanks to Texaco's effective lubrication, average lube oil consumption for all engines is an economical .000592 gallons/kwh., fuel cost is only 5.14 mills/kwh.

LUBRICATE your engines with one of the world-famous *Texaco Ursa Oils.* It's your best assurance of full-power, dependable performance at low maintenance costs.

There is a complete line of *Texaco Ursa Oils*—especially refined to make diesel, gas and dual-fuel engines deliver *more power* with *less fuel* over *longer periods* between overhauls.

Operators everywhere have found that *Texaco Ursa Oils* prevent harmful deposits and stuck rings, assure proper compression and combustion. These outstanding benefits are so consistently delivered that—

For over 20 years, more stationary diesel h.p. in the U. S. has been lubricated with Texaco than with any other brand.

Whatever the type of your engines, whatever the operating conditions—there is a *Texaco Ursa Oil* to assure highest efficiency at lowest possible cost. Let a Texaco Lubrication Engineer help you make the best selection.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

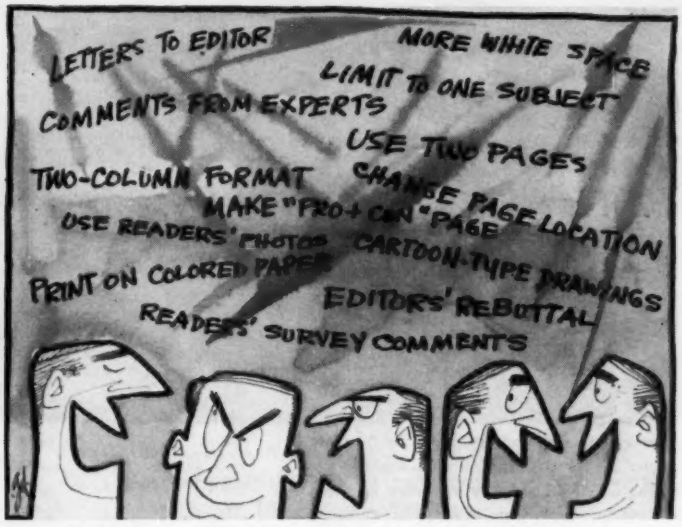
TEXACO

TEXACO URSA OILS

FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES

speaking of **Power**

Now, Power editors brainstorm for new ideas . . . and get results



Creative sessions: another technique for improving editorial quality

Staff meetings are a regular thing in most editorial offices: to plan future issues, discuss major coming reports, ferret out trends and expose them to staffers for comment. About a year ago POWER editors gathered for a different type staff meeting: a purely creative session for garnering all possible ideas on a then-current problem. In brief, we were brainstorming for fresh ideas. It paid off then and since.

A few weeks back, the staff brainstormed *Arguments* page, left. The aim: How to make this page more useful to readers. First, we quickly reviewed brainstorming rules. Then, with a staffer standing chalk in hand at a blackboard, the mental plug was pulled allowing a free flow of ideas: good, bad, simple, complex, feasible, impractical. And the ideas did tumble out. Within 25 minutes, 36 ideas found their way to the blackboard. Whether imminently useful or not, they all had one common characteristic: Each was mentally peeled off a staffer's mind without critical analysis by the donor or his colleagues. On next month's *Arguments* page you'll see the first of several changes culled from brainstorming.

Creative sessions on POWER have become simply another technique for improving editorial quality. When brainstorming sessions are properly handled, ideas come tumbling out, one often pyramiding upon another. Several rules for brainstorming are musts.

An early user of the technique, Alex Osborn (author of *Creative Imagination* and member of the advertising firm of Batten, Barton, Durstine and Osborn) feels any truly creative session is relatively fruitless unless the following basic rules are adhered to:

1. *Judicial judgment is ruled out.* Criticism of ideas must be held until each item is screened through the mesh of practicality.
2. *Freewheeling is welcomed.* The wilder the idea, the better since it's much easier to tame down than think up.
3. *Quantity is wanted.* More ideas falling into the hopper increase the likelihood of winners.
4. *Combination and improvement are sought.* In addition to popping in ideas of their own, participants should be on the lookout for ways to turn the ideas of others into better ones.

The ever-readiness to judge another's fresh idea on the spot proved our major stumbling block in the early brainstorming stage. Setting up road barriers at this stage throttles creative thinking in any group setting out to garner all possible ideas in clearing up a given problem.

After brainstorming, next step is filtering out the one or more really workable suggestions. On POWER, several senior editors sit down, weigh each idea in the light of experience, readers' interest. If we come up with one fresh workable idea, we feel well rewarded.

L N ROWLEY *Editor*

B G A SKROTZKI *Engineering and Management*
S M ELONKA *Operation and Maintenance*
T G HICKS *Special Projects*
J J O'CONNOR *Managing Editor*
H P KALLEN *Associate Editor*
R C BELLAS *Assistant Editor*
N PEACH *Assistant Editor*
C F SANDERS *Assistant Editor*
A S THORNTON *Assistant Editor*
C F MARSCHALEK *Art Editor*
F A ANNETT *Contributing Editor*

P W SWAIN *Consulting Editor*

DOMESTIC NEWS BUREAU: *Atlanta, Cleveland, Detroit, Houston, San Francisco, Washington*

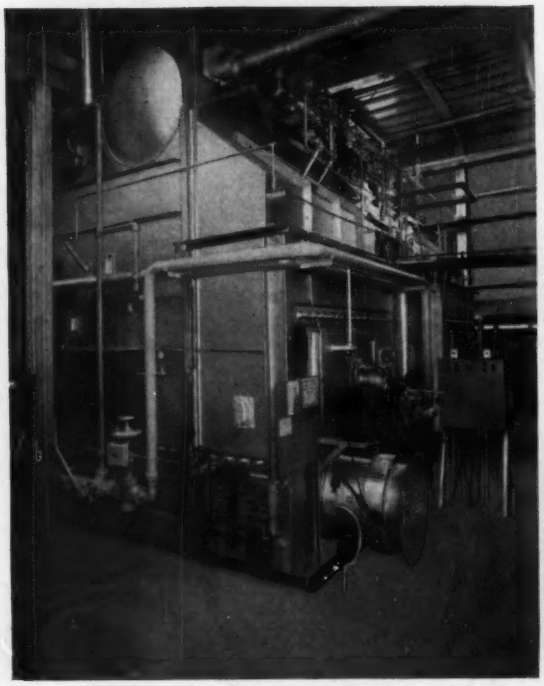
WORLD NEWS OFFICES: *London, Paris, Bonn, Tokyo, Bombay, Rio de Janeiro, Mexico City*

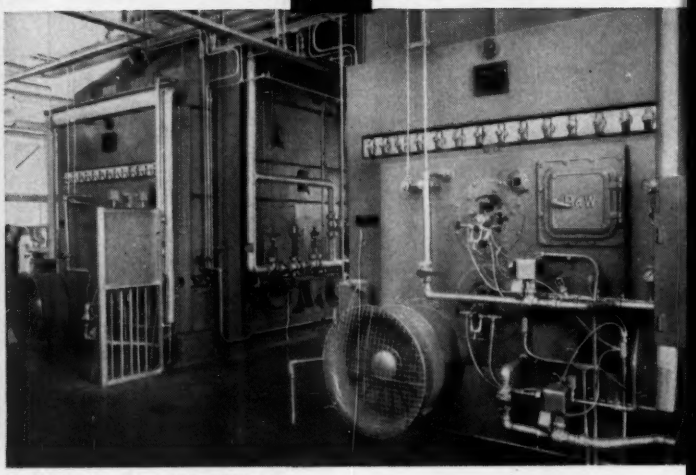
SHELTON FISHER *Publisher*

CLARK BOUGHTON *Sales Manager*

DISTRICT MANAGERS

W R KLEIN, 330 W 42nd St, New York 36, N. Y.
J E DEAN, 330 W 42nd St, New York 36, N. Y.
C R LONG, Architects Bldg, Philadelphia 3, Pa.
L W ROMIGH, 520 N Michigan Ave, Chicago 11, Ill.
W K PONDER, 1510 Hanna Bldg, Cleveland 15, Ohio
R J McGURK, Continental Bldg, St. Louis 8, Mo.
W D LANIER Jr, 801 Rhodes-Haverty Bldg, Atlanta 3, Ga.
G L JONES Jr, 1020 Adolphus Tower, Dallas 2, Tex.
R C ALCORN, 68 Post St, San Francisco 4, Calif.
H L KEELER, 1125 West Sixth St, Los Angeles 17, Calif.



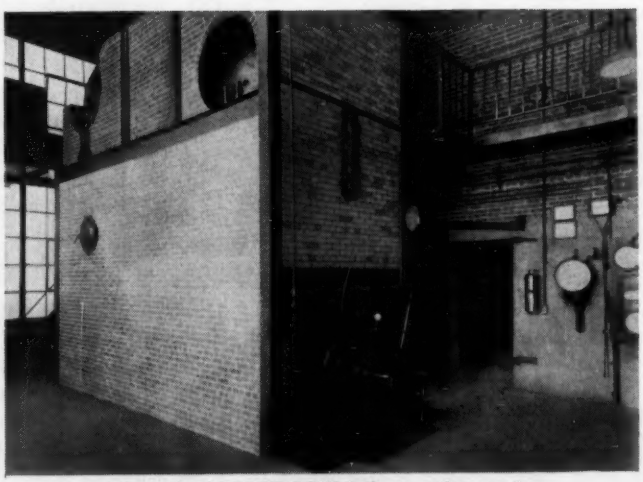


Both Kansas City Plant and Gastonia, N. C. Plant, newest of the H&D plants, have two 18,000 lb per hr boilers. The Kansas City boilers use either gas or oil depending on availability. The Gastonia boilers use oil only. All these boilers have forced-draft fans mounted directly on the burner windbox.

B&W BOILERS:

A 35-YEAR ACCEPTANCE STORY AT HINDE & DAUCH H&D

Hinde & Dauch operates corrugated box factories in major markets of the East, Midwest, and South



This oil-fired 150 HP B&W Boiler went into service in 1930, at H&D's Baltimore box factory.

The Hinde & Dauch Paper Company is one of the country's largest manufacturers of corrugated paper materials. Its remarkable growth since 1882, from a single threshing machine and straw baler, has been paced by ingenuity in adapting the product to varying conditions—virtually making markets where none previously existed.

As a leading corrugated box manufacturer, H&D requires an efficient, dependable steam source in each of its many plants scattered around the country. And since 1921, when three 516 HP B&W Boilers went into service in the company's Fort Madison, Iowa plant, The Hinde & Dauch Co., has been using B&W Boilers of various types and capacities in its plants from Watertown, Massachusetts to Kansas City, Kansas—the strongest possible indication of acceptance based on performance.

Since 1946, B&W Boilers for H&D have been of the Integral-Furnace Type. In its newest plant at Kansas City, Kansas, two B&W Integral-Furnace Boilers went into service in November of 1955. Each unit provides 18,000 lbs of steam per hr and is equipped for oil and gas firing. Some of the other H&D installations have provision for future stoker firing, to afford full benefit from fuel price fluctuations. Today there are 19 B&W Boilers in service at H&D plants, for a total of 275,000 lb of steam per hr.

For the past 35 years, Hinde & Dauch has been relying on B&W Boilers for dependable, economical steam. Like many more industrial concerns in various categories, this company has found B&W Integral-Furnace Boilers ideally suited to its steam requirements, both processing and heating. Take a tip from this long association if you are considering steam plant modernization or expansion. B&W Integral-Furnace Boilers are available in individual capacities to meet any requirements from 2900 to 350,000 lb of steam per hr.

Write for complete details to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd St., New York 17, N.Y.

B&W INTEGRAL-FURNACE BOILERS
OFFER THESE 10 COST-SAVING ADVANTAGES

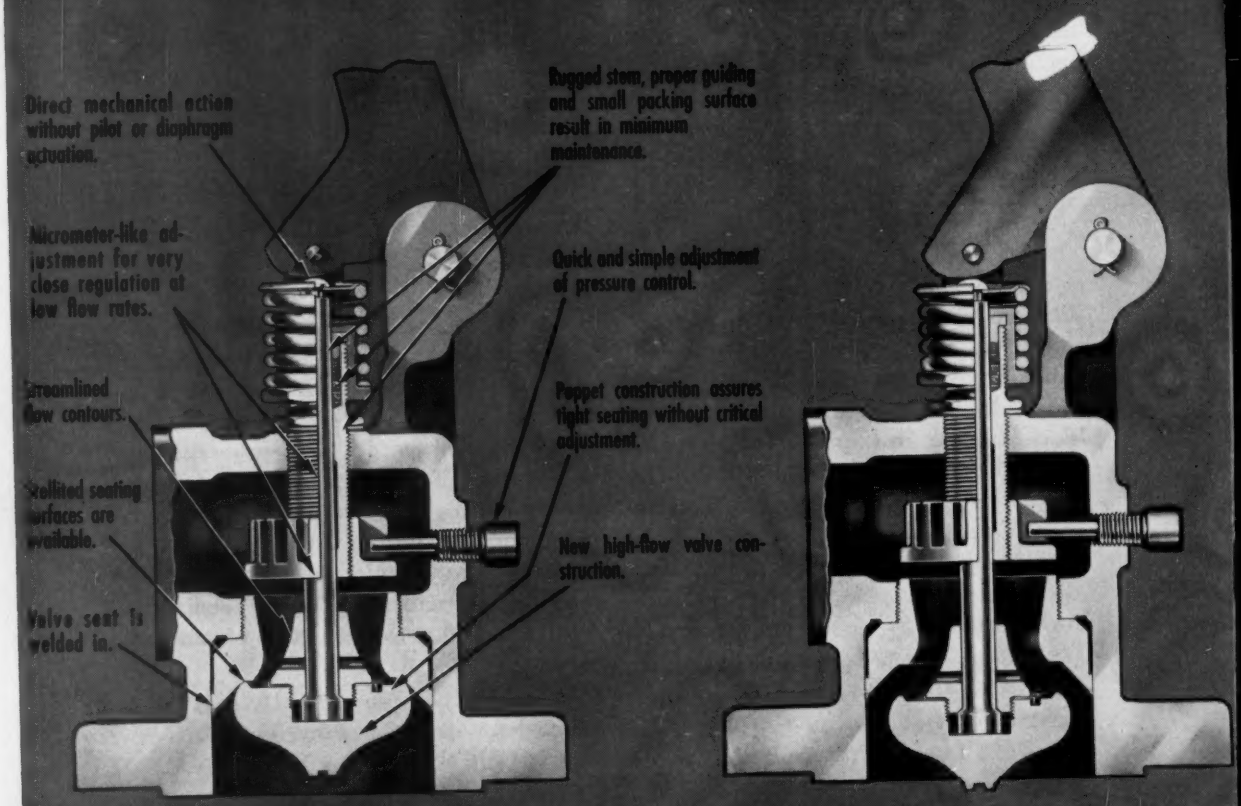
- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings, even with high boiler water concentration
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

BABCOCK & WILCOX

BOILER DIVISION

G-777

POPPET TYPE VALVES


Direct mechanical action without pilot or diaphragm actuation.
Micrometer-like adjustment for very close regulation at low flow rates.
Streamlined flow contours.
Stellited seating surfaces are available.
Valve seat is welded in.
Rugged stem, proper guiding and small packing surface result in minimum maintenance.
Quick and simple adjustment of pressure control.
Poppet construction assures tight seating without critical adjustment.
New high-flow valve construction.

CLOSED

OPEN

Demands on a soot blower valve are extremely severe . . . performance requirements very high. Long experience has shown that the poppet type valve is the most satisfactory unlubricated valve for such rugged work. (It is also used in automobile engines.) The Diamond Poppet Type has proved its superiority by many years of successful operation on the most difficult jobs . . . it is an important factor in the outstanding performance of the blowers shown on the opposite page.

NEW streamlined flow contours substantially reduce pressure drop. Valve design assures tight seating without close adjustments. Valve seat is welded in on all steel valves; Stellited seating surfaces are available. The valve readily lends itself to examination and repair. Disc and seat are quickly accessible, and regrinding can be done quickly without dismounting the head. Seat, disc and stem are corrosion resistant stainless steel.

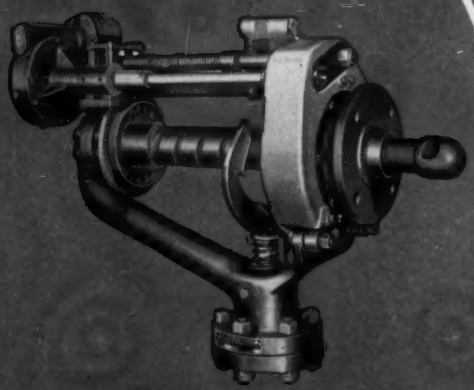
The integral adjustable pressure control device is used when boiler pressure is higher than desirable for blowing . . . but not so extreme as to require a separate pressure reducing valve. It permits accurate setting of the blowing pressure for each blower individually . . . entirely independent of every other blower. It is easily and quickly adjusted . . . consists of a ribbed disc carried on the threaded valve stem guide. Its location outside the path of valve travel permits full and immediate opening of the poppet valve, thus avoiding wire drawing. Throttling is at the back seat so that the main seat is spared the damaging action of this duty. No orifice in line is necessary.

The poppet valve is one of the many reasons why Diamond Blowers give *better boiler cleaning at lower cost.*

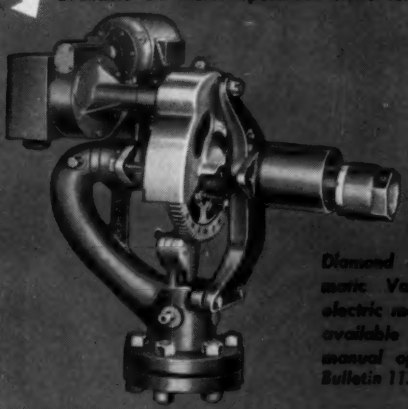
Model IK valve shown above; Models IR and G9B valves have same advantages. 7549

An IMPORTANT REASON for the better performance of these Diamond Blowers

Diamond Model IK Long Retracting Blower with mechanically operated valve. Electric motor operated unit shown; also available air motor operated. Write for Bulletin 1080A.



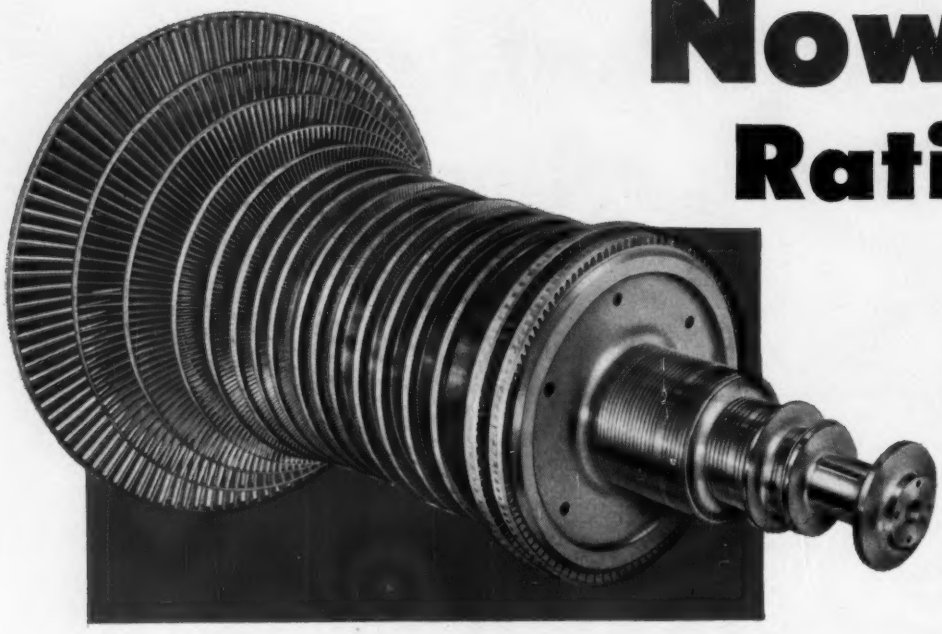
Diamond Model IR Short Retracting Blower with air motor operation; electric or manual operation also available. Write for Bulletin 1079.



Diamond Model G98 Automatic Valved Blower with electric motor operation; also available with air motor or manual operation. Write for Bulletin 1137U.

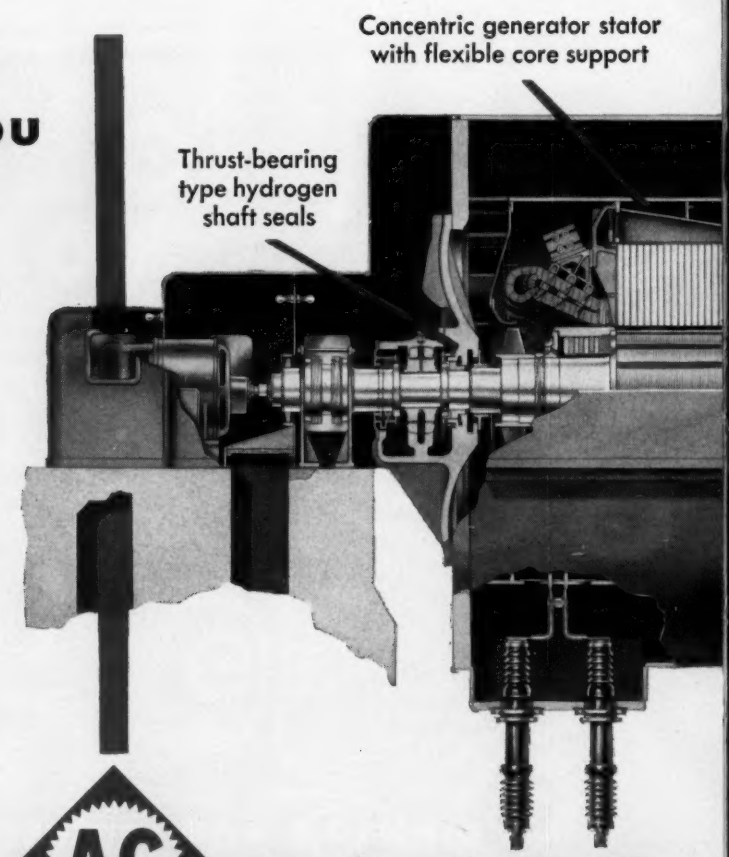
DIAMOND POWER SPECIALTY CORPORATION
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

Now in Ratings



Here is the turbine rotor for one of the 16,500-kw units now being built. For this 850-psig, 900-F AIEE-ASME turbine, rotor shaft and wheels are of integrally forged construction.

Allis-Chalmers Turbines Give You MORE Modern Design Features



CUTAWAY VIEW of 16,500-kw unit shows the development of impulse turbine design for larger ratings.

A-C ALLIS-CHALMERS

ALLIS-

Production up to 16,500 Kw

NEW Large WA-Series Turbines Offer

Advanced
● Design Features

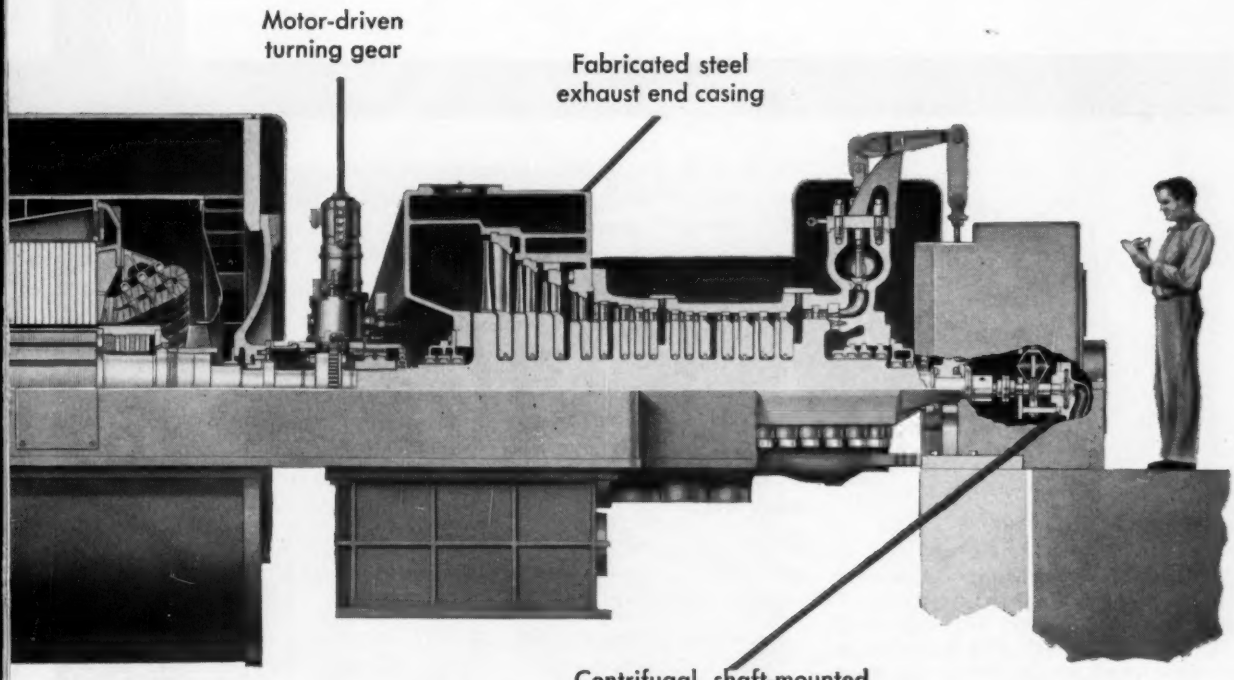
Simplified
● Installation

AIEE-ASME
● and NEMA Ratings

NEW WA-Series steam turbine-generator units now being manufactured include the 10,000-kw NEMA standard rating as well as 12,650-kw and 16,500-kw AIEE-ASME preferred standard condensing ratings. The 16,500-kw units have hydrogen-cooled generators.

Incorporated in the design are time-proved labyrinth steam sealing, removable external glands, high chrome alloy steel buckets and nozzles, reliable governing system, and unit shipment and installation — plus additional large turbine and generator features.

To get MORE information on economical, dependable units 2000 kw and larger, call the nearest A-C district office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.



CHALMERS

LIVE BETTER ELECTRICALLY

A-5127

HERE'S PROOF:

9 OUT OF 11 UTILITIES PREFER BAILEY INSTRUMENTATION

In October, 1955, eleven electric utilities added a total of 966,619 KW of steam generating capacity. The installations ranged from 6,000 KW up to 270,000 KW.

9 of the 11 installed Bailey meters
7 of the 11 have Bailey combustion control
9 of the 11 are using Bailey feed water control
6 out of 10 use Bailey steam temperature control

In 31 out of a possible 43 applications in these power plants, Bailey equipment was chosen. And in 6 of the 11 stations, Bailey was the exclusive choice in all applications.

This unanimity of preference for Bailey . . . from Michigan to Georgia, from Maine to California . . . suggests just one conclusion:

Regardless of plant size, regardless of plant location, Bailey is the first choice of America's utilities.

Make Bailey your choice.

For breadth of product line, depth of experience, size of field service organization, no one offers more to the power industry than Bailey. And the time to contact Bailey is during the early planning stage when our recommendations can save time, trouble and money.

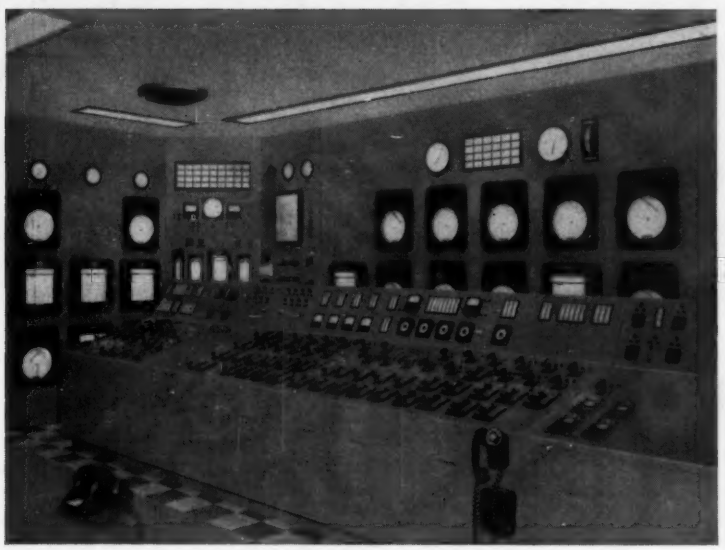
NEW STEAM-ELECTRIC GENERATION PLACED IN OPERATION DURING OCTOBER 1955

SOURCE—REPORTS TO FEDERAL POWER COMMISSION AS PUBLISHED IN ELECTRICAL WORLD DEC. 12, 1955

STATE	UTILITY	PLANT	CAPACITY (KW)	METERS ON BOILER	COMB. CONT.	F.W. CONT.	S.T. CONT.
Maine	Central Maine Power Co.	Mason	30,000	X	X	X	X
N. Y.	New York State Electric & Gas Corp.	Milliken	108,000	X	O	X	O
Ohio	Ohio Edison Co.	R. E. Burger	270,000	X	O	X	X
Ind.	Crawfordsville Electric Light & Power Plant	Crawfordsville*	11,500	O	O	O	O
Ind.	Indiana-Kentucky Electric Corp.	Clifty Creek	180,000	X	X	X	X
Mich.	Upper Peninsula Generating Co.	Presque Isle	22,000	X	X	X	O
Kans.	Central Kansas Power Co.	Colby	6,000	X	X	X	
Ga.	Georgia Power Co.	Hammond	100,000	X	X	X	X
Tex.	West Texas Utilities Co.	Paint Creek†	30,000	O	O	O	O
Calif.	California Electric Power Co.	Highgrove	40,000	X	X	X	X
Calif.	Pacific Gas & Electric Co.	Morro Bay	169,118	X	X	X	X

Code: X—BAILEY, O—OTHERS. *Bailey Fluid Meter †Bailey Oxygen and Combustibles Recorder

A129-2



In the control room of Hammond station, Georgia Power Company, they use Bailey meters and Bailey controls for combustion, feed water, and steam temperature. Out of October, 1955's steam plant additions, some Bailey equipment was chosen for each of the 11 plants.

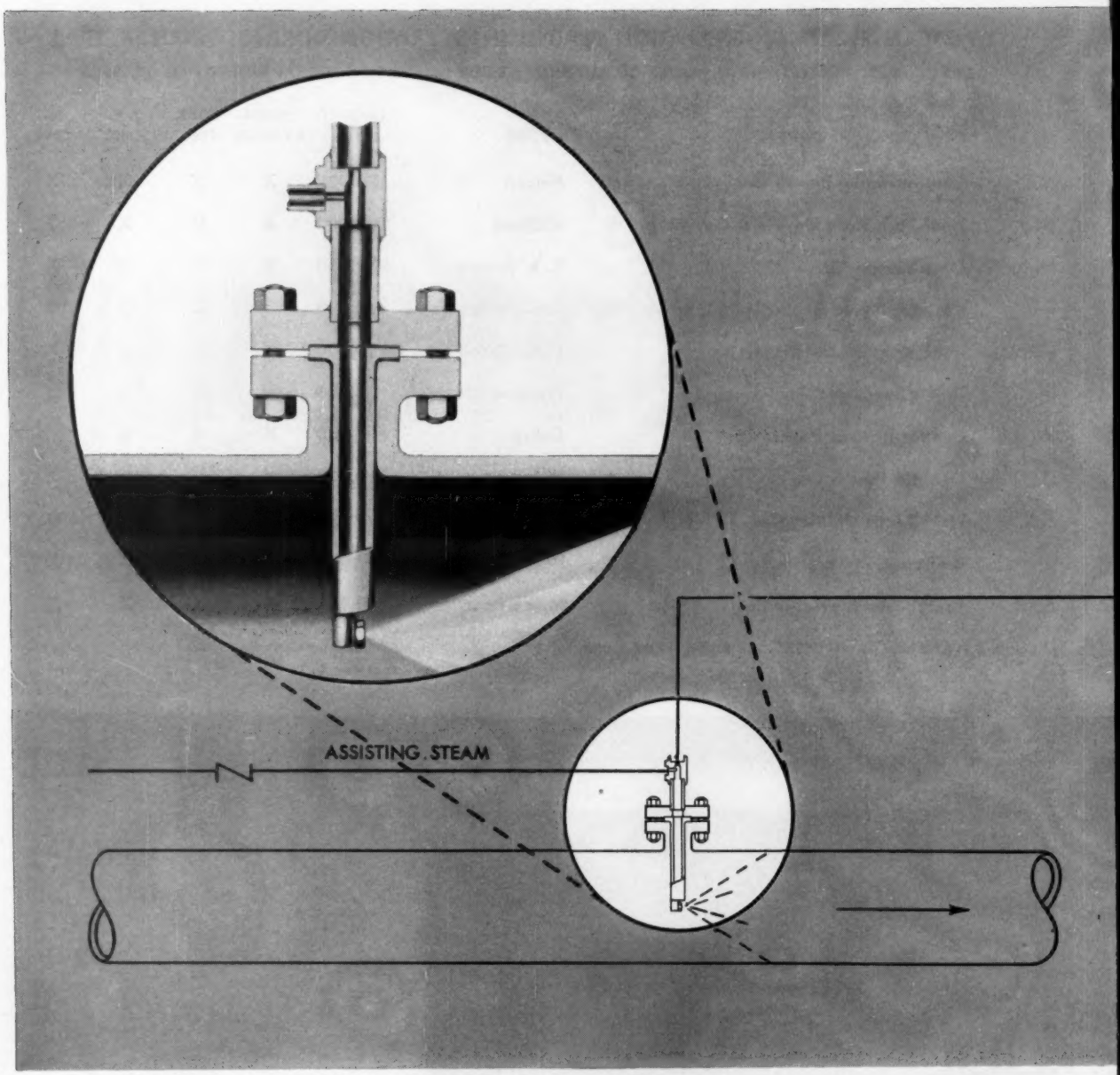
Instruments and controls for power and process

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS



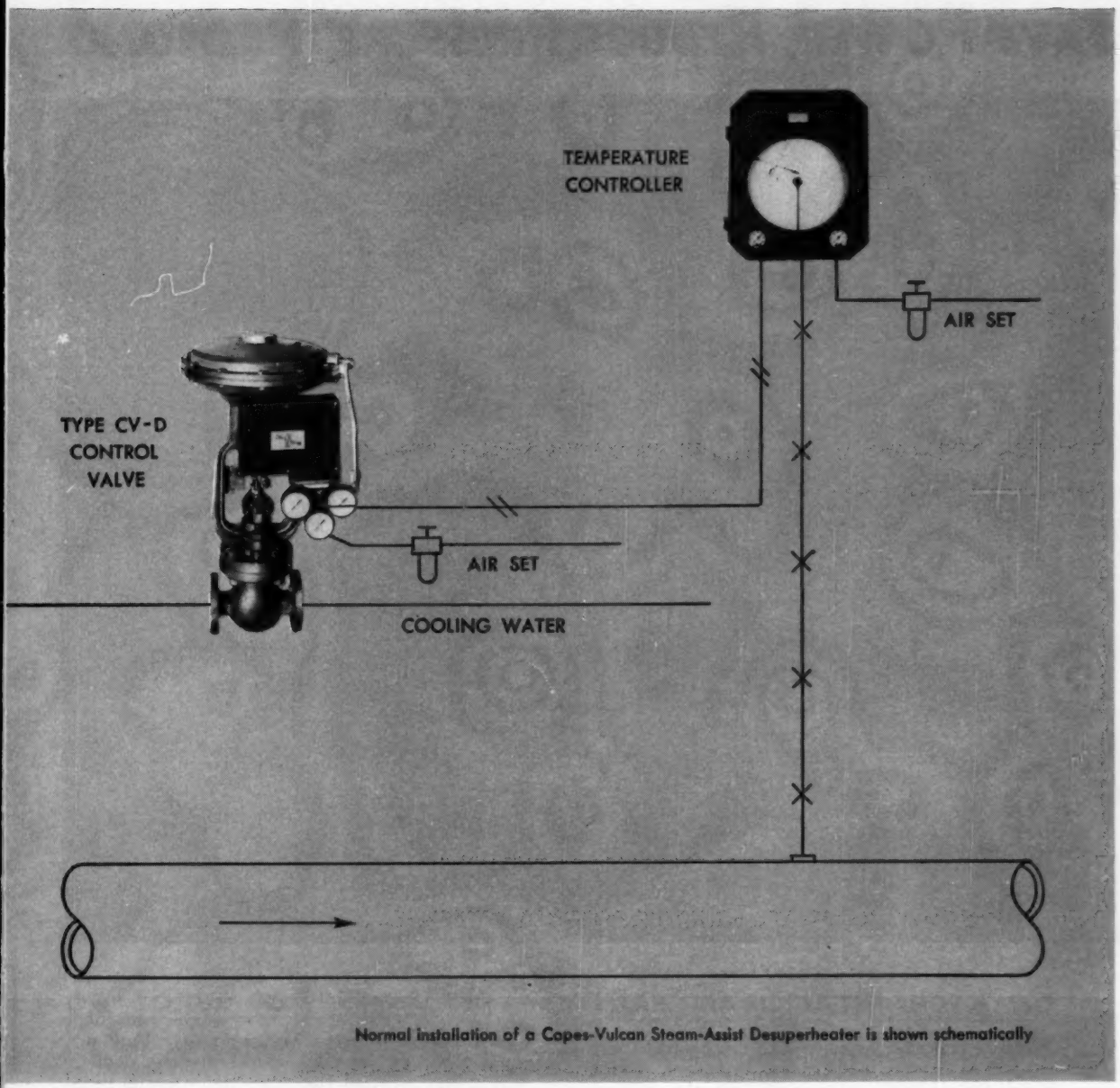
Both carburetor and in-line types are available in the new Copes-Vulcan Steam-Assist Desuperheater.

Get more accurate control with the NEW

Here is a desuperheater based on a new, proven principle that delivers more accurate control of final steam temperature for process work or auxiliaries. It uses steam only on lighter loads. As load increases, the flow of assisting steam is automatically reduced—normally without an atomizing-steam valve. Assisting steam can be off completely at high loads where no more than mechanical atomization is needed. Control is close, even at 10 degrees above saturated temperature.

Cooling water and assisting steam are intimately mixed in the exclusive Swirl Chamber—upstream from the point of injection. No large steam bubbles form to cause annoying hammer or vibration.

Incorporated into the station for close modulating control of cooling water flow is the new Copes-Vulcan Type CV-D



Normal installation of a Copes-Vulcan Steam-Assist Desuperheater is shown schematically

Copes-Vulcan Steam-Assist Desuperheating Station!

Valve. It is designed for the exact operating characteristics suited to your needs.

Enjoy the benefits of Copes-Vulcan desuperheating, custom-engineered for your individual requirements. Be sure of accurate control, minimum maintenance and long service life. Write for Bulletin 1024.

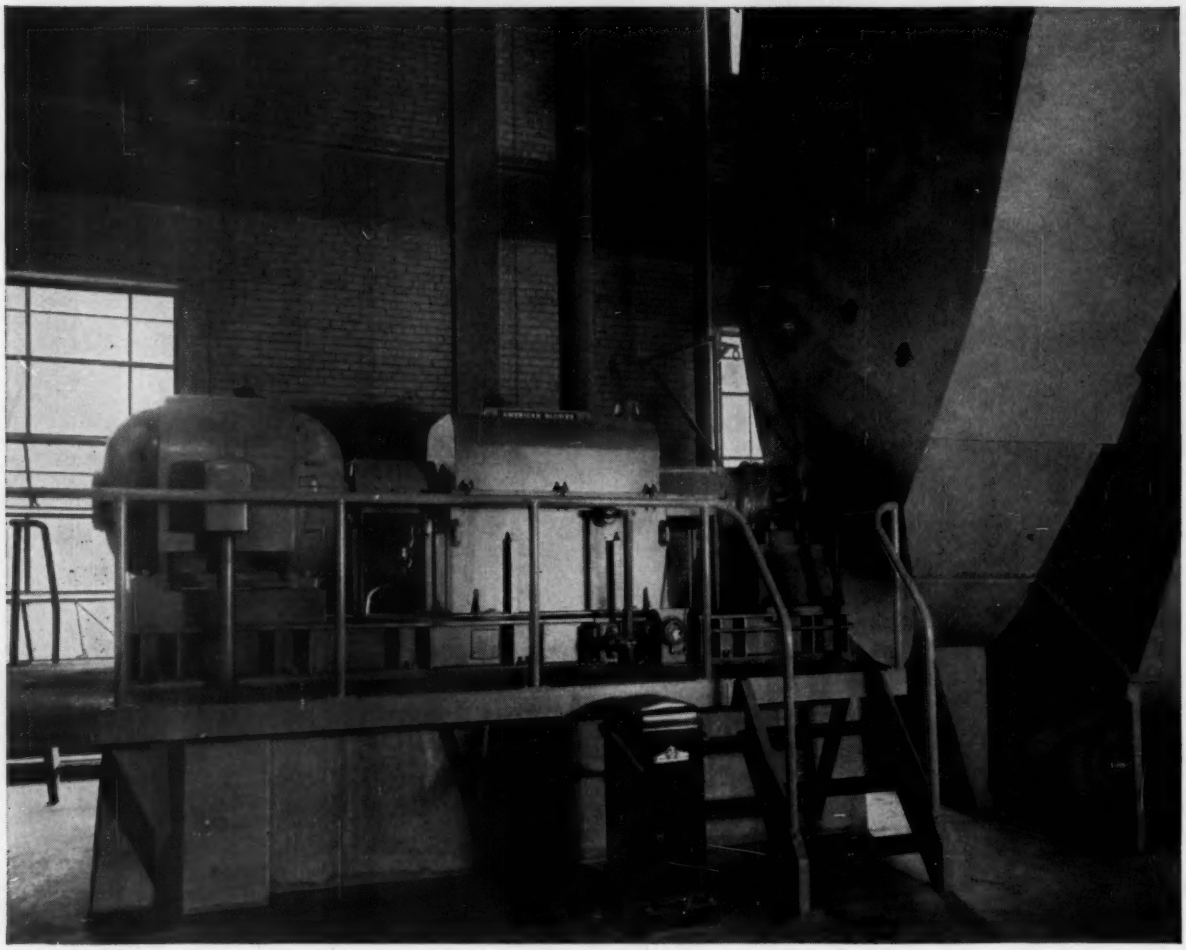
50th Anniversary
BLAW-KNOX
1906-1956

COPES-VULCAN DIVISION

BLAW-KNOX COMPANY

ERIE 4, PENNSYLVANIA

SAVE POWER, REDUCE PRESSURE, PROLONG



ON MECHANICAL DRAFT FANS

Accurate and efficient control of mechanical draft is vital in modern power-plant operation. Gyrol Fluid Drive is the answer for all the control requirements of this important job.

To begin with, Gyrol Fluid Drive transmits power through a vortex of oil, providing infinitely adjustable speed control to keep the fan always operating at its optimum design or selection point.

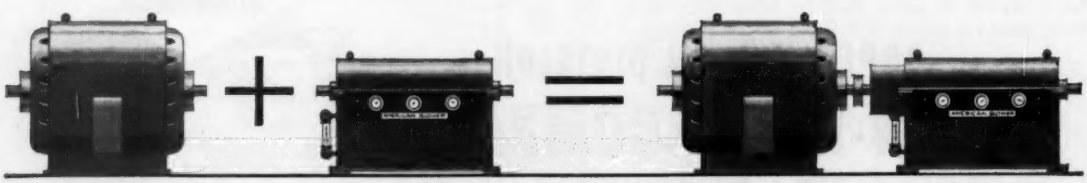
. . . This saves horsepower, gives good stable volume and pressure control over the operating range.

. . . This simplifies motor-starting equipment, and in many cases simplifies basic motor design for the mechanical-draft application.

. . . This reduces damaging high- and long-duration inrush currents on the motors; eliminates starting shocks; provides no-load starting of high WR^2s that assist in the new, high-volume, high-pressure fan wheels.

. . . This prolongs life of fan bearings, and reduces fly-ash abrasion on fan wheel, fan scroll, inlet boxes, and breeching connections.

Add to these advantages the reduction in noise level—not only a boon to operating personnel, but of especial importance in outdoor plants—and you have a total of power-saving, cost-saving benefits which are overwhelmingly in favor of Gyrol Fluid Drive for your next power-plant expansion.

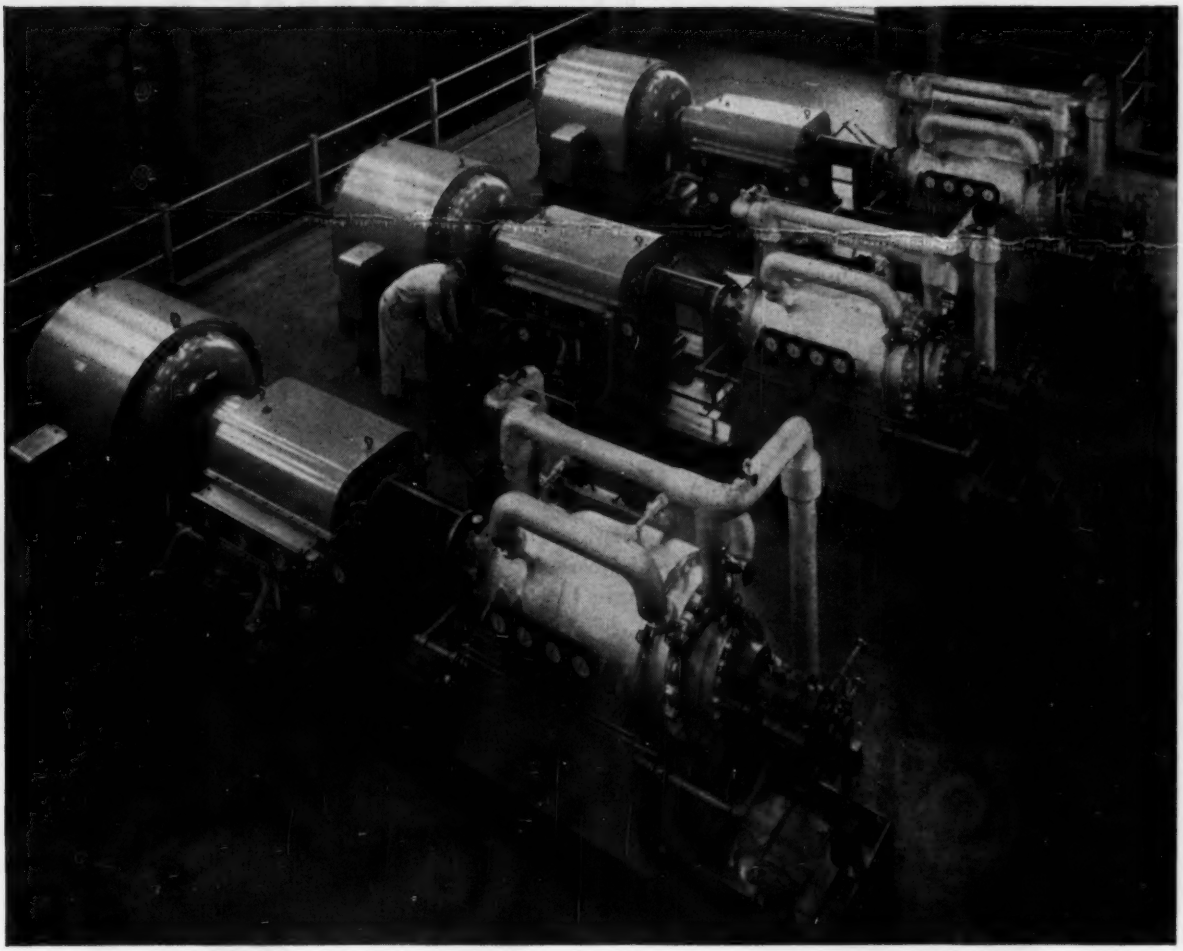


Rugged constant-speed induction motor

American Blower Gyrol Fluid Drive

Smooth, adjustable-speed control

EQUIPMENT LIFE WITH GÝROL FLUID DRIVES



ON BOILER FEED PUMPS

Of all power-plant auxiliaries, the boiler feed pump consumes the greatest single segment of invested power. To release more of this power to consumer lines, more and more power plants of all sizes are turning to Gýrol Fluid Drive for pump control.

For one thing, Fluid Drive saves power over the entire operating range by eliminating wasteful throttling by valves.

Secondly, on modern high-pressure boiler installations, Fluid Drive permits reduction in pressure, because of its adjustable-speed feature — resulting in further power savings.

And Fluid Drive reduces wear on bearings and other vital pump parts by letting the pump operate at speeds that fit boiler demands.

In addition, paralleling of pumps is simplified. And change-over from operating to standby pump is quick and easy — for there's no need for boiler shutdown.

Weigh these facts thoroughly when your expansion program reaches the planning stage. Better yet, talk them over with an American Blower engineer. His knowledge of the application of Gýrol Fluid Drives in modern power plants can prove valuable to you. Call our nearest branch, or write: American Blower Corporation, Detroit 32, Michigan. In Canada: Canadian Sirocco Company, Ltd., Windsor, Ontario.

AMERICAN BLOWER

Division of American-Standard

it's boiler check-up time!

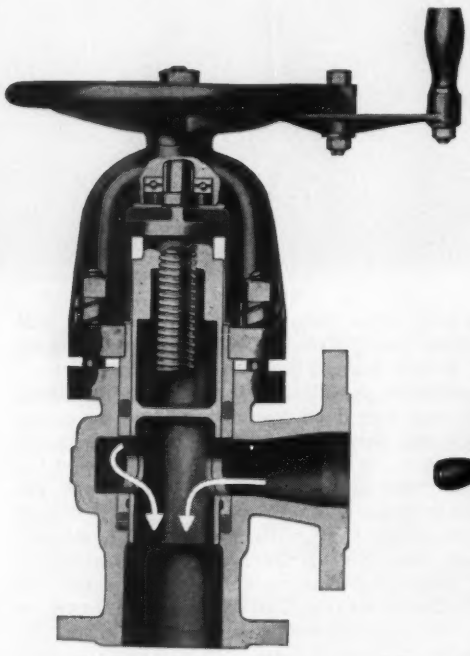
✓ HOW ARE YOUR BLOW-OFF VALVES?

Are they drop-tight? Rugged and dependable? Easy to maintain?

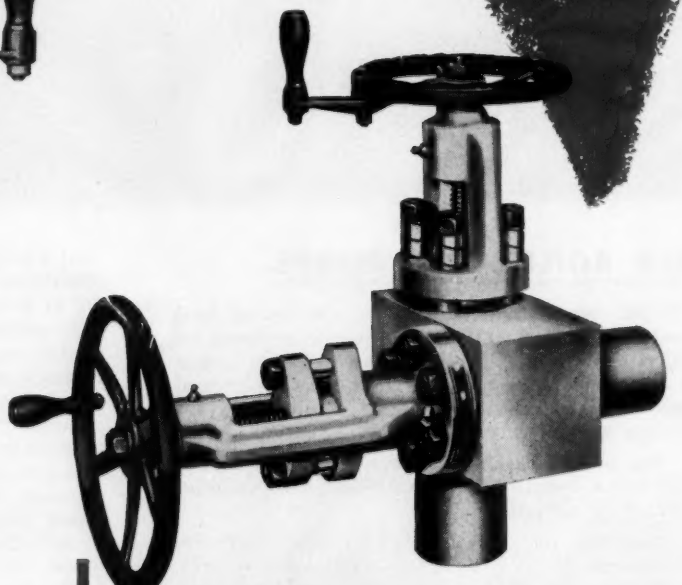
Just as important, do they have all the advantages and up-to-date improvements in materials and design of new YARWAY Blow-Off Valves?

Old YARWAY Blow-Off Valves also can be overhauled and modernized, because all YARWAY improvements are *interchangeable* with parts on earlier models.

Write today for YARWAY Blow-Off Valve CHECK SHEET—also new YARWAY Blow-Off Valve Catalog B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).



Yarway Seatless valve for low and medium pressures. Features balanced nitralloy plunger that seals line drop tight—yet permits free, unobstructed flow in blow-down. **Used in over 15,000 boiler plants.**



Yarway Unit Tandem Blow-Off Valve for higher pressures. Combines Yarway Seatless Valve and Yarway Hard-Seat Valve, or two Yarway Hard Seat Valves, in a one-piece forged steel body. For years—the choice of 4 out of 5 high pressure power plants.

YARWAY steam

✓WHAT ABOUT WATER COLUMNS AND GAGES?

Are they in good working order? Are they up-to-date?

Is the water level clearly visible from the operating floor? YARWAY Gages equipped with Type "M" Illuminators make the meniscus "shine like a star"—even under adverse conditions.

Now's the time to install modern YARWAY Water Columns and Gages. Twelve distinct improvements in YARWAY Gages have increased gage life—decreased gage maintenance. Write for latest Catalog WG-1812.

✓HOW ABOUT ADDING NEW REMOTE LEVEL INDICATORS?

Remote readings of boiler water level at any spot in the plant are a recognized convenience—and easy with new "Wide Vision" YARWAY Remote Liquid Level Indicators.

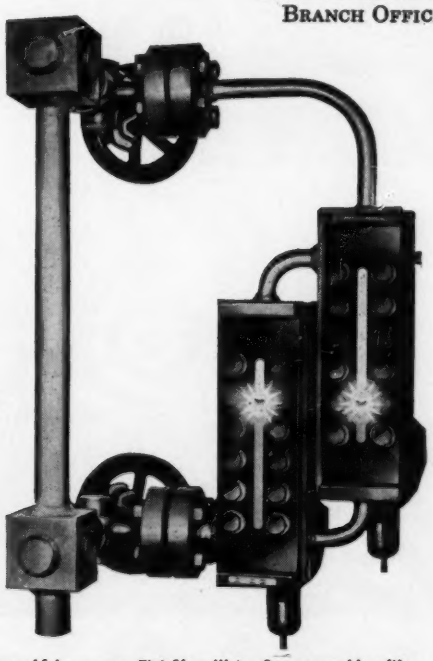
Because the indicating mechanism is operated by the boiler water itself, response is always instant, readings always accurate.

YARWAY Hi-Lo Graph Recorder not only gives remote indication but also a 24-hour recording of water levels.

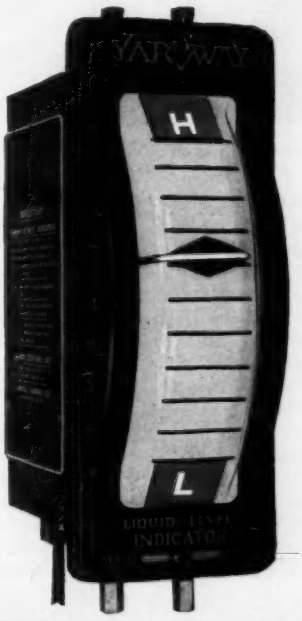
YARWAY Remote Indicators and Recorders can also be supplemented with Remote Hi-Lo Alarm Signals—light or horn.

Write for Catalog WG-1823.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



Yarway high pressure Flat-Glass Water Gage assembly with tie-bar type circulating water column. Note separated design, expansion loops, flanged connections and Type "M" Illuminators. Other columns and gages for lower pressures.



Yarway Remote Liquid Level Indicator with new "wide vision" face. Manometric type with automatic temperature compensation where required. Over 10,000 used throughout industry.

plant equipment

THREE WICKES

N LOS ANGELES HEALTH BUILDING

IS THE

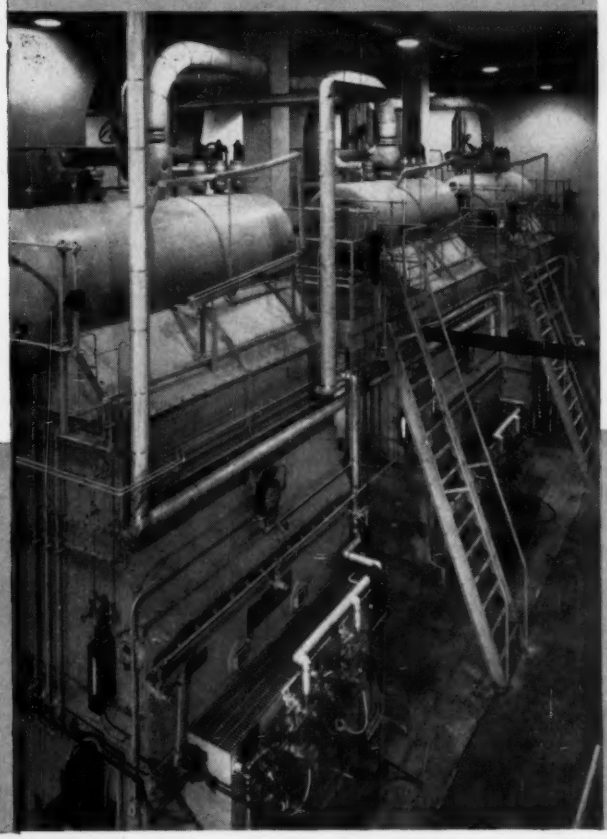
Architects: Lunden, Hayward, and O'Connor
Builder: Robert E. McKee General Contractor, Inc.

Housed **in the striking modern structure shown here is a new clinic and health center for the city of Los Angeles Health Department. Beautifully equipped in every respect, the building has individual room thermostats to insure the exact desired temperature in each separate area . . . clinics, laboratories, medical sections, and others. To insure that the heating system responds immediately to these controls, the builders installed three dependable Wickes water tube steam generators. In addition to supplying the big nine-story Health Center with heat, the Wickes boilers also serve the entire City Hall building nearby, and the new Police Facilities building (a feature of this integrated Civic Center layout is that these buildings are connected to the Health Center by pedestrian tunnels, which are likewise heated by the Wickes boiler installation). Pictured at right is one of the modern health laboratories.**

WICKES

STEAM GENERATORS WHERE DEPENDABILITY MOST VITAL FACTOR

The three Wickes boilers shown below supply heat for not only the Health Center but also the City Hall and new Police building.

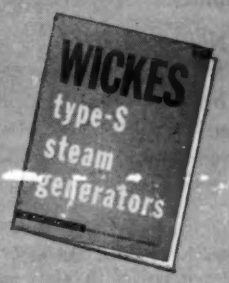


These 2-drum type-S Wickes steam generators are compact and efficient water tube units. Built to a design pressure of 160 psi, and with 3400 square feet of heating surface, each of these Wickes units is fired by 2 Multijet Combination gas and oil burners. They are quickly responsive to extreme fluctuations in load, and the large steam drums make certain of ample steaming capacity with dry steam. Wickes 2-drum type-S steam generators are readily adaptable to completely automatic control.

Other Wickes 2-drum, type-S, modern steam generators are available in the Series S1A and S2A. These units combine the water cooled furnace as an integral part of the boiler, adapting the high and low type furnace to the desired method of firing . . . coal, oil or gas. They are built to the design pressure of 725 psi; superheaters and recovery equipment are available.

WRITE FOR OUR NEW BROCHURE

Our new Catalog 55-2 contains complete information on Wickes 2-drum type-S steam generators. A general description is given of these modern efficient boilers, together with four insert pages of engineering drawings and data. We will also send you our complete facilities Bulletin No. 35-1.



161

THE WICKES BOILER CO.

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • *SALES OFFICES:* • Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tulsa • Washington, D. C.

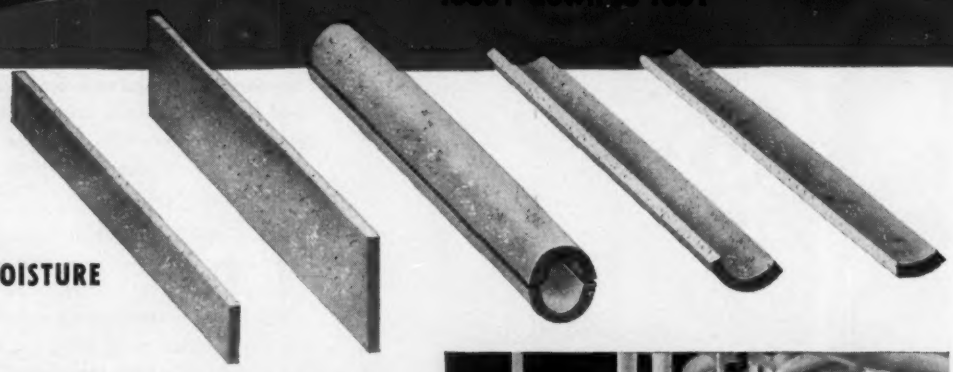
EAGLE
EP
PICHER

there's something NEW

NEW

EAGLE-PICHER HYLO

PIPE AND BLOCK INSULATION
insulates from
1600 F down to 100 F

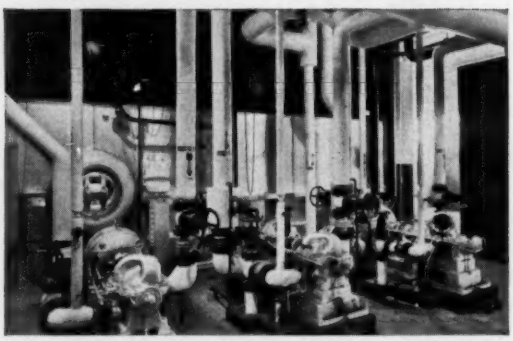


EASILY WORKABLE
EASY TO APPLY
UNAFFECTED BY MOISTURE

Eagle-Picher HYLO is a combination of special inorganic silicas and asbestos fibers. It is non-brittle, easily workable and keeps its high thermal efficiency and strength, even after exposure to excessive heat and moisture.

HYLO's internal shrinkage is lowest of all tested comparable insulations. Does not crack or open up from shrinkage, thus retaining highest efficiency.

"Nesting O.D." pipe covering sizes provide accurate, tight fits for multiple layer construction. Every size and thickness fits over or into another size and thickness, permitting a wide range of unusual assemblies and the advantage of building up many thicknesses from a limited number of "prime" units.



Eagle-Picher HYLO is designed for insulating both flat and curved surfaces, and is especially suitable for conditions where the surface is irregular and where you find an easy-to-cut and easy-to-apply insulation essential.

The addition of HYLO and 85% MAGNESIA PIPE AND BLOCK to Eagle-Picher's line of industrial insulations makes available a complete group of effective insulations for every industrial application. Complete information about our entire line available upon request. Why not write today?

Since 1843

EAGLE
EP
PICHER

EAGLE-PICHER

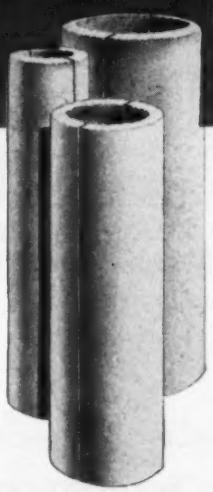
The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

PRODUCING A COMPLETE LINE OF INDUSTRIAL INSULATIONS

under the Eagle-Picher label

NEW EAGLE-PICHER 85% MAGNESIA

PIPE AND BLOCK INSULATION recommended for insulating heated pipes and equipment operating at temperatures up to 550-600F.



EAGLE-PICHER PIPE SECTIONS

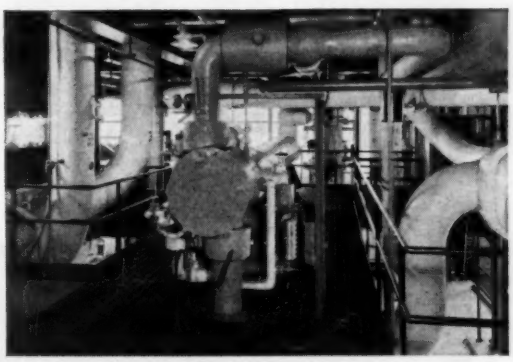
Extreme light weight
Low thermal conductivity
Attractive smooth finish

EAGLE-PICHER 85% MAGNESIA BLOCKS

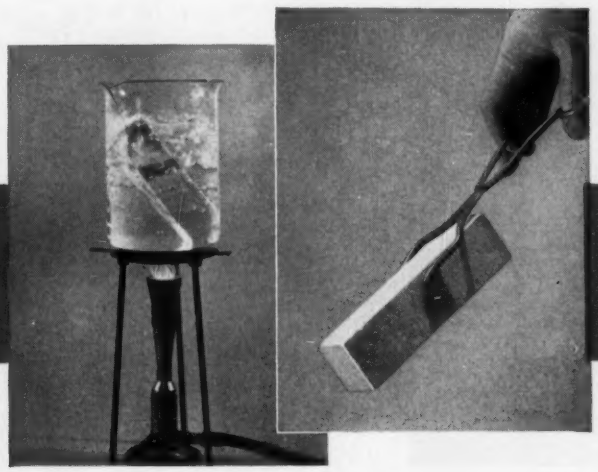
• Smooth surfaces • Uniform thickness • Sharp true edges

Pipe sections! Blocks!

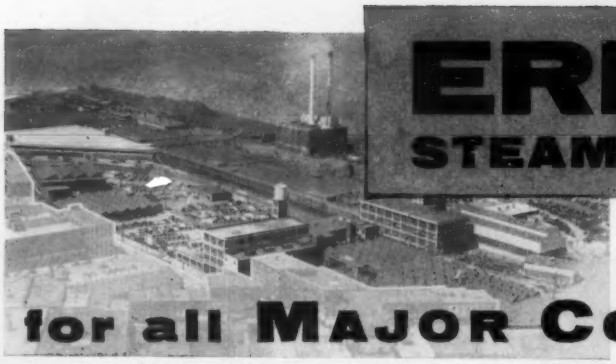
EAGLE-PICHER 85% MAGNESIA combines light weight, high strength, low conductivity, resistance and high dimensional stability . . . factors that assure superior performance, extra years of service.



Pipe coverings and blocks are molded to exact size and thickness. The result is a smooth "rind" appearance that is not only attractive, but tends to strengthen the structure—also provides superior "suction" for holding cement finishes.



After a 24-hour bath in boiling water, EAGLE-PICHER 85% MAGNESIA shows no evidence of disintegration nor change in shape—a quality derived from its chemically "set" monolithic structure.



ERIE CITY STEAM GENERATORS at ONE for all MAJOR COMPONENTS . . .

The recent installation of modern Erie City 2-Drum Steam Generators at this Muskegon, Michigan plant provided "Undivided Responsibility" for Continental Motors Corporation. All the major components of these 100,000 lbs./hr. generators, including the boilers, air heaters, superheaters and stokers, were engineered and manufactured by Erie City Iron Works. Erie City also erected these generators and will provide any future service that is required.

Here at Erie City each component of our steam generators is designed to complement the other for maximum economy. Each component is engineered to meet specific performance requirements and to guarantee the highest efficiency. These and many more benefits are yours when you purchase complete steam generators by Erie City Iron Works. For a quick picture of our complete line of steam generating equipment write for Bulletin SB-5022.

ERIE CITY
116 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

data:

BOILERS, 2-DRUM
2 E. C. 100,000 lbs./hr.
Design pressure: 700 p.s.i.g.
Total steam temperature: 750°F.

AIR PREHEATERS
2 E. C. Single Pass

SUPERHEATERS
2 E. C. Pendant Type

SPREADER STOKERS
2 E. C. "Travegrate"

Continental Motors Corporation

RESPONSIBILITY—

BOILERS

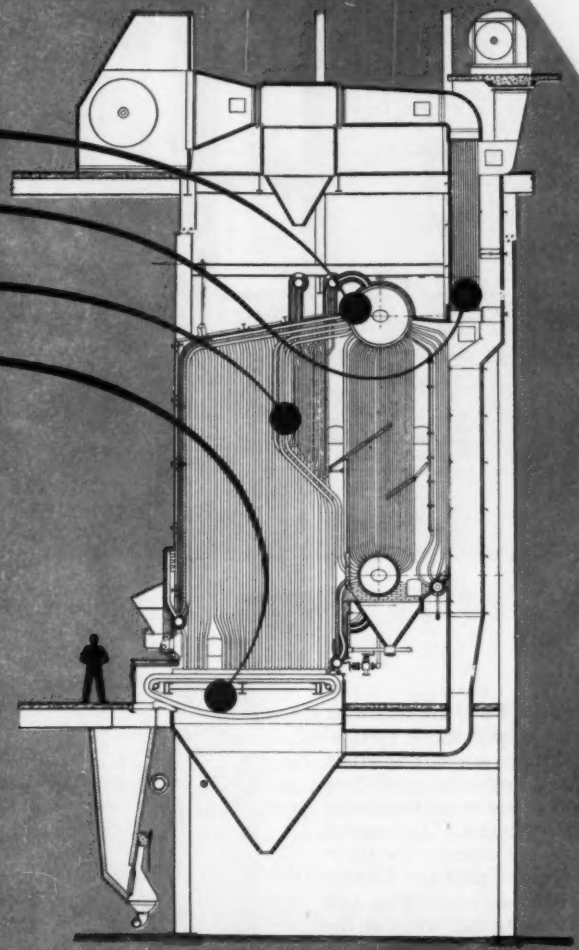
AIR HEATERS

SUPERHEATERS

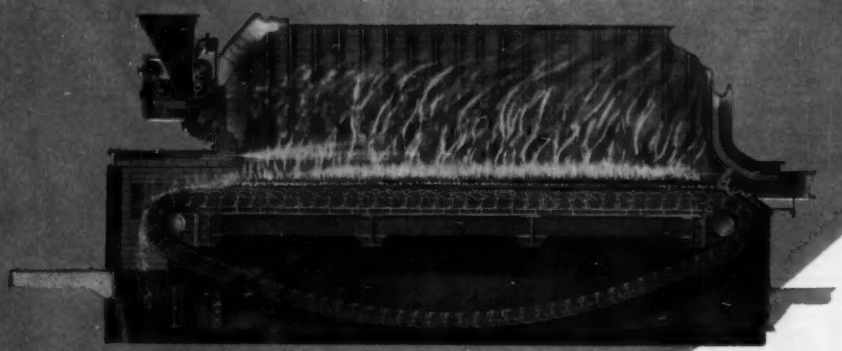
STOKERS

ERECTION

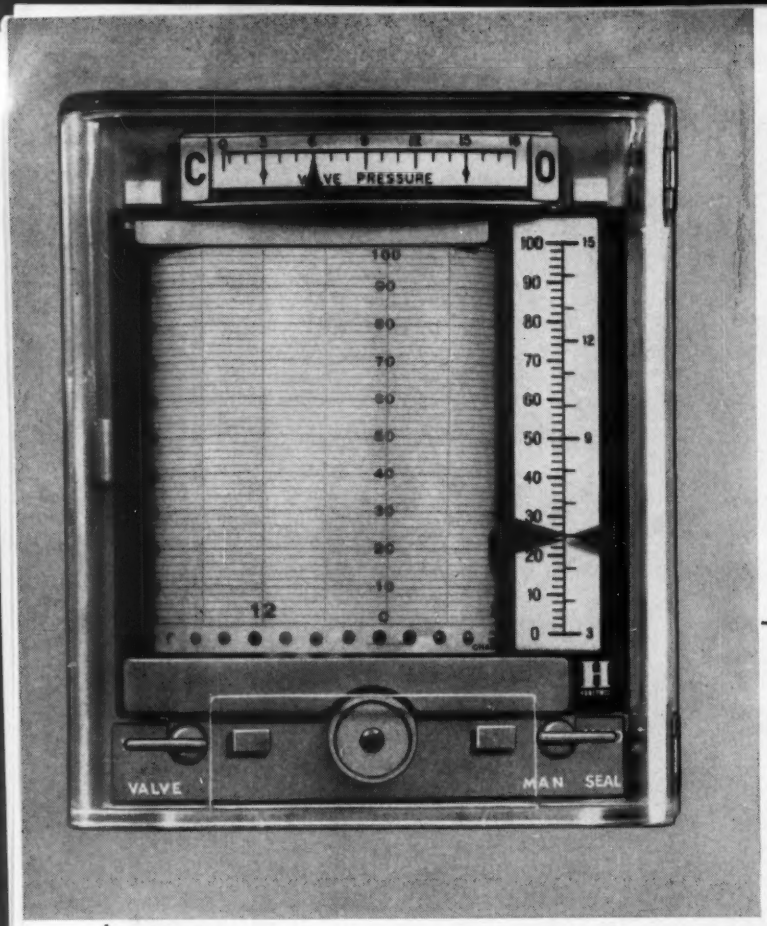
SERVICE



Roland W. Berger & Associates
Mansfield, Ohio
Engineers

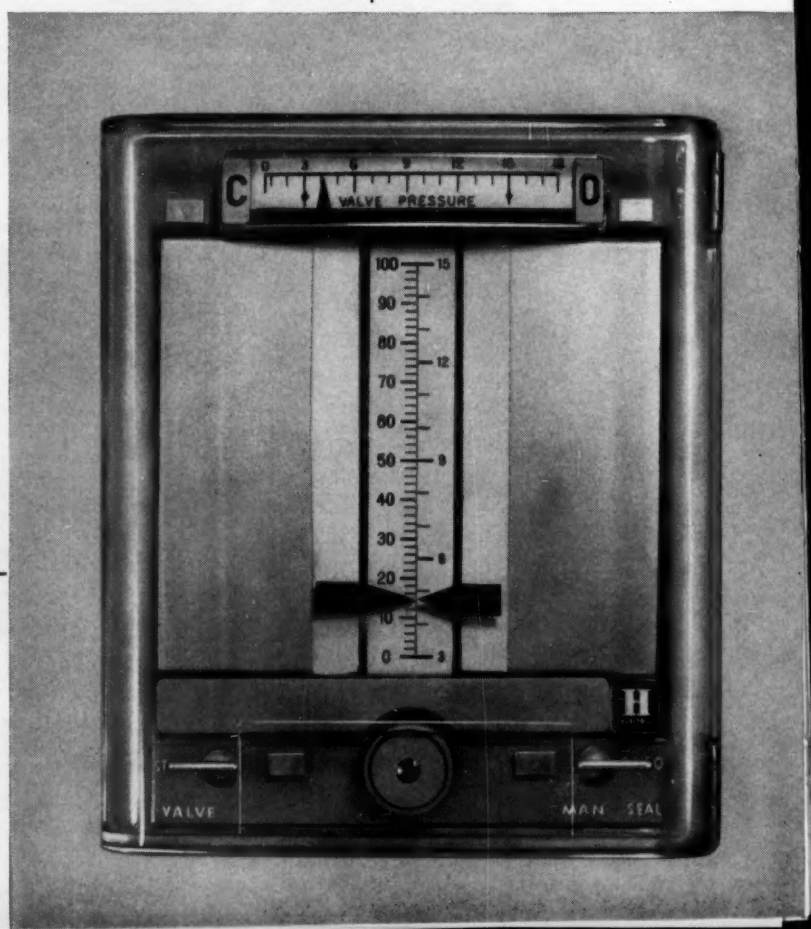


"Travagrate" Continuous Ash Discharge Spreader Stokers by Erie City Iron Works.
Rugged in design, economical in operation, highest in performance.
Detailed information available. Write for Bulletin SB-42.



for simplest

Both the *Tel-O-Set* indicator and recorder have vertical indicating scales on which large, opposing pointers clearly show measured value and set point. The control knob and transfer switches are located near the bottom of the case, where they can be manipulated without the operator's hand obscuring the view of the pointer and scale.



● **REFERENCE DATA:**

Write for Bulletin 7202.

Design your instrumentation

installation, startup, service

–with *Tel-O-Set* instruments

The exclusive features designed into *Tel-O-Set* miniature instruments save you time, trouble and money . . . from the instant these instruments are installed on your control panels.

Easy installation. The indicating and recording chassis is a complete assembly that can be supplied separate from the case. Since the case contains the valve pressure gage and pressure regulator, you can install it in the panel, make complete piping connections . . . and then insert the instrument chassis later, at startup.

Foolproof startup. Because it can be shipped separately, the chassis is protected against dirt and damage until it is ready to begin service. Air lines can be checked, control valves stroked and final inspection made *before* the chassis and controller are installed.

Serviced in seconds. Down-time for instrument maintenance is eliminated, for a complete chassis can be replaced in just a few seconds. There is no loss of control during replacement . . . no disturbance to electrical connections. To adjust zero and span, or to inspect parts, you can partly withdraw the chassis from the case, without interrupting operation.

Tel-O-Set instruments can handle a broad range of temperature, pressure, flow and liquid level applications. They work with any type of pneumatic force-balance controller. They are sensitive and accurate . . . have true linear calibration . . . respond instantly to changes in measured variables. For a discussion of how you can use them profitably, call your local Honeywell sales engineer . . . he's as near as your phone.

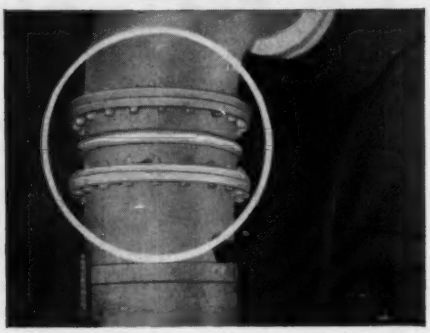
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

How long can a U. S. Rubber Expansion Joint last



...some have been on the job since 1926, the year they were invented!

Here are just a few reasons why *these flexible connections are used in pressure or vacuum pipe lines...*

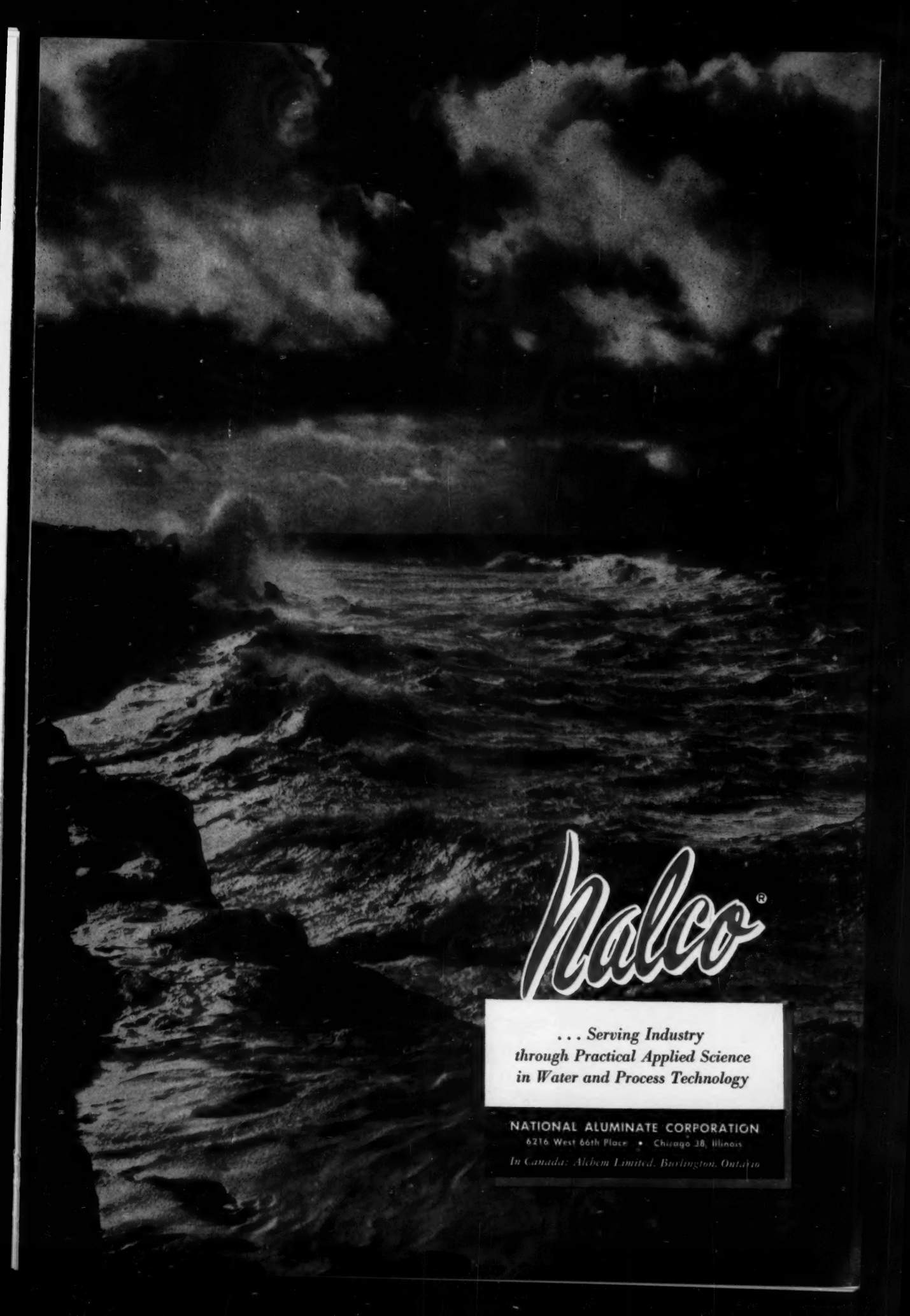
- U. S. Rubber Expansion Joints are resilient and, therefore, do not, like metal, set permanently when compressed.
- Constant flexing merely keeps "U. S." joints "alive"...prevents them from becoming brittle.
- They absorb both axial *and* lateral deflection far more than metal joints. Greater insulation against vibration and pump noises is provided.
- There is never any electrolysis, corrosion or erosion.
- U. S. Rubber joints handle pressures from 40 lbs. to 125 lbs. Compare!
- The outside diameter of the arch is smaller than that on metal joints. Face-to-face dimensions (even with multiple arches) are smaller.
- Weight is much less. This, plus the fact that no gasket is needed between flanges (unlike metal joints) results in a more easy installation, lowering the cost.

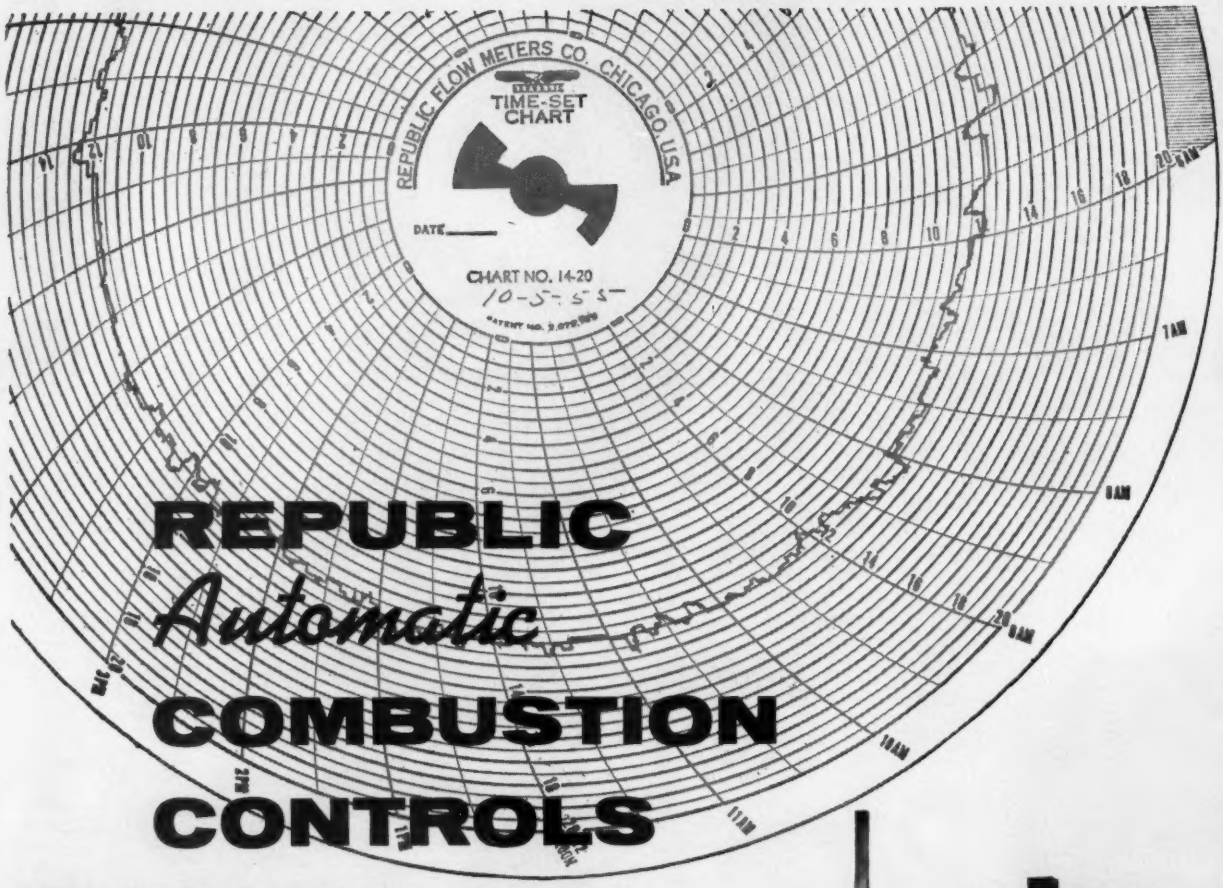
"U. S." was the first to develop rubber expansion joints. They are at work in every kind of industry, prolonging the life of equipment in pressure or vacuum pipe systems. Obtainable at any of the 28 "U. S." District Sales Offices, or write us at Rockefeller Center, New York 20, N. Y.

US RUBBER

Mechanical Goods Division

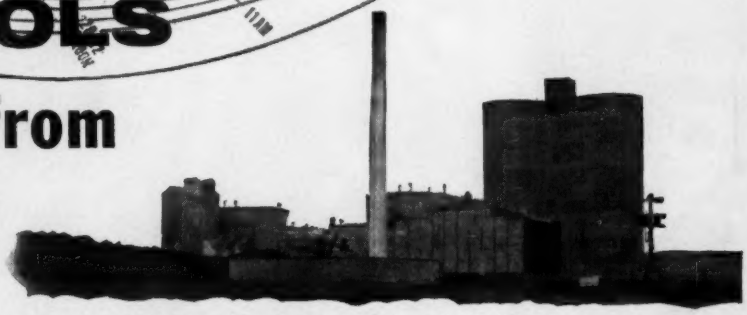
United States Rubber


halco®
. . . Serving Industry
through Practical Applied Science
in Water and Process Technology
NATIONAL ALUMINATE CORPORATION
6216 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario



REPUBLIC *Automatic* COMBUSTION CONTROLS

Get High CO_2 from Low Grade Coal



at UTAH-IDAHO SUGAR COMPANY'S NEW $7,000,000 PLANT

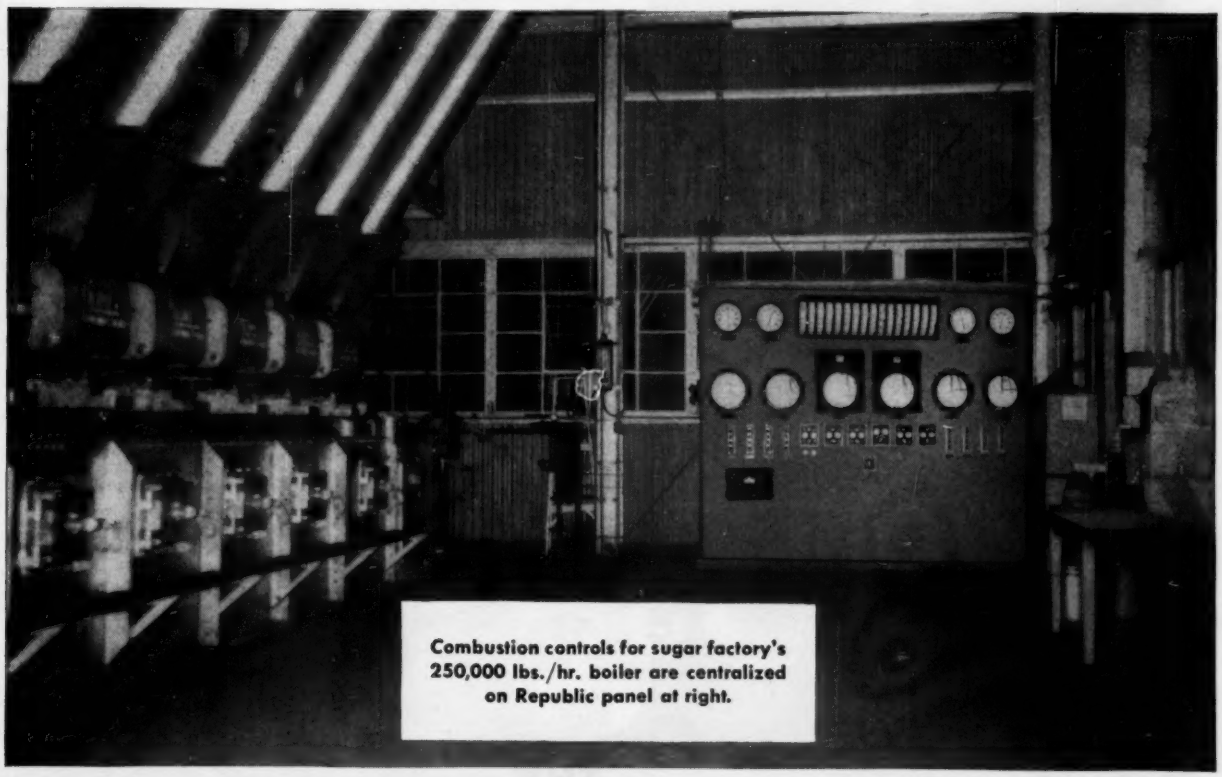
In any power plant, the percentage of CO_2 in combustion gases is indicative of combustion efficiency. But at the power plant for Utah-Idaho Sugar Company's new sugar beet factory, Moses Lake, Washington, a good CO_2 performance record is more than desirable. It's actually essential! That's because the plant supplies not only steam, but CO_2 as well to sugar-making processes. The CO_2 is extracted from combustion gases and becomes a vital ingredient in the production of over 75,000,000 lbs. of sugar and thousands of tons of molasses the factory produces annually. With the plant limited to low grade western coal, continuous maximum combustion efficiency at all loads is necessary to insure adequate CO_2 for processes.

Republic Automatic Combustion Controls enable the plant's spread stoker fired 250,000 lbs./hr. boiler

operating at 400 psig and 575°F. to meet CO_2 requirements while matching steam supply to process demands. Daily CO_2 charts indicate the boiler is consistently producing 12–13% CO_2 in spite of the quality of coal burned.

According to operators, ash removal, cleaning of the fire and soot blowing can be carried out with the combustion controls on automatic without disturbing the fuel-air ratio. Furnace draft is controlled satisfactorily despite the high stack on the plant. Turbine drives on forced and induced draft fans are speed controlled by the combustion controls, eliminating the need for dampers. A three element Republic boiler feedwater system is also tied in with the combustion control system to automatically supply the proper amount of water to the boiler at all steaming rates.

This plant is one more example of how Republic combustion engineers design control systems that enable boilers to exactly meet individual plant requirements. There are Republic Combustion Controls for any size or type of boiler, for all methods of fuel firing, all arrangements of draft and all load conditions. When you want to be sure of getting maximum boiler performance, ask Republic to design and build your combustion control system.



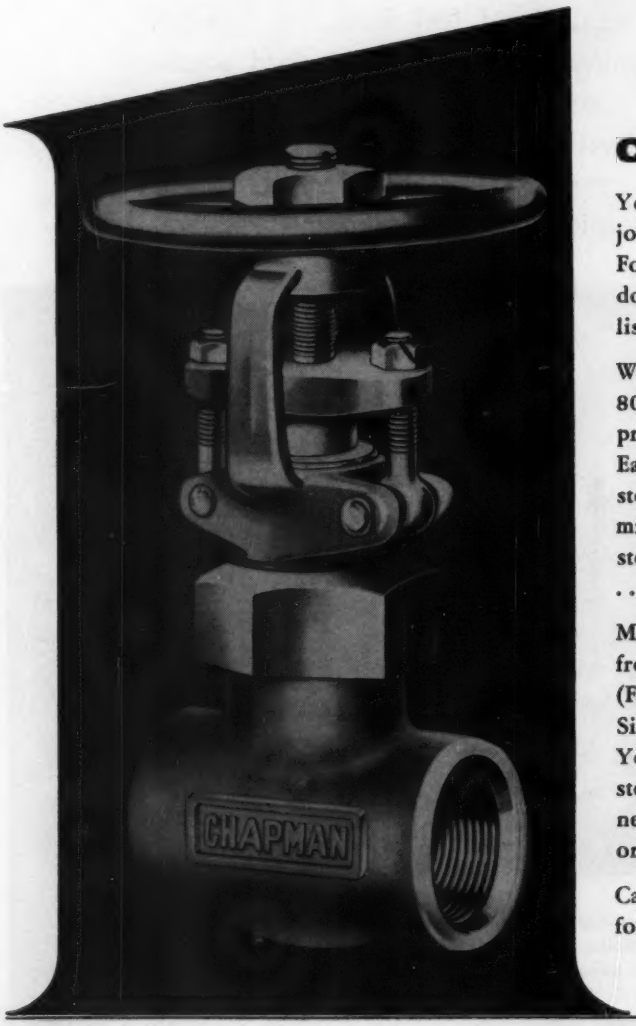
Combustion controls for sugar factory's 250,000 lbs./hr. boiler are centralized on Republic panel at right.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

No. 1 on the List

for small forged steel gate valve jobs



CHAPMAN LIST 960

You'll find more Chapman List 960 valves on more jobs than other small forged steel gate valves. For standing up and keeping maintenance costs down it's tops, by far, on the valve man's preference list. The reasons are sound and several.

Wedge gate faces are super hard . . . hardened to 800 Brinell by Chapman's exclusive Malcomizing process. They won't . . . *they can't* seize or gall. Easily replaceable seat rings are hardened stainless steel. Wear on seating surfaces is brought to a minimum. Bolted follower on the outside screw rising stem type has no exposed threads on its yoke . . . nothing that's easy to corrode.

Made to take . . . and stand up under . . . pressures from 380 psi at 1000° F. to 2000 psi at 100° F. (For higher ratings use Chapman List 990 valves.) Sizes from ¼" to 2" in many different alloys. You can have either rising stem with yoke or rising stem with inside screw. And, depending upon your needs, the Bonnet joint is either ground metal-to-metal or gasketed.

Catalog 10 has full information. It's required reading for men interested in valves. Write for your copy today.

THE CHAPMAN VALVE MANUFACTURING CO.
INDIAN ORCHARD, MASSACHUSETTS

Progress in turbine-generators

How General Electric provides maximum reliability in turbine-generator armature insulation

About preceding page illustration

HIGH-VOLTAGE TESTS TO DESTRUCTION are used to determine how much G.E.'s armature insulation can withstand. Forced to carry voltages far above their rating, test bars first develop corona streamers, then finally fail, enabling engineers to discover the insulation's actual voltage strength.

99.85% service availability highlights performance of turbine-generator armature insulation

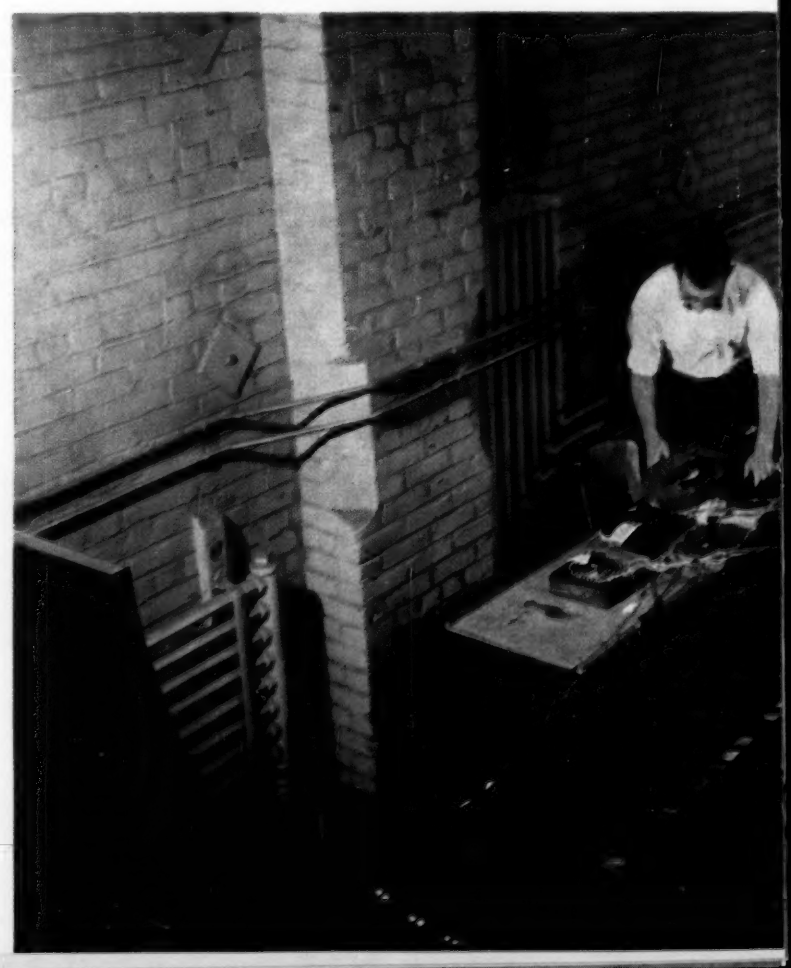
G-E design combines both electrical endurance and mechanical toughness

Primary among the many factors affecting a turbine-generator's long-term service availability is the quality of its armature insulation. It must withstand high voltages over long periods of time. And at operating temperatures it must endure the variable stresses caused by differential thermal expansion and contraction within the generator.

General Electric insulation measures up to these requirements with an already proved service availability of 99.85 percent in turbine-generators.

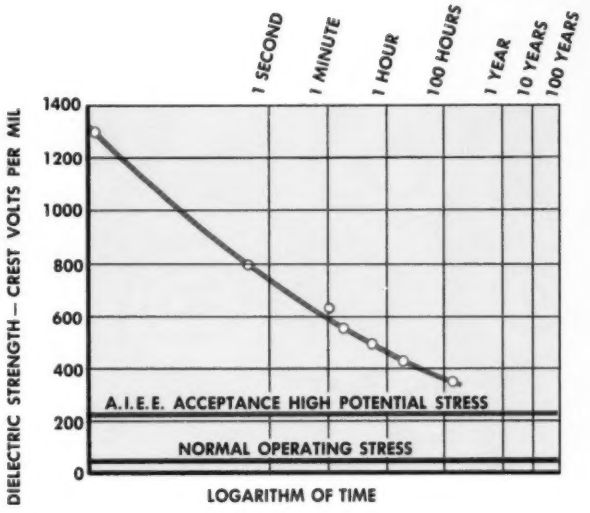
Progress in other areas of generator development often influences the performance of insulation. Larger capacities, higher voltages, different cooling methods all present new problems. To make sure that insulation quality keeps pace, each new generator development includes rigorous tests of insulation under the new set of conditions.

The illustrations on these pages show typical insulation tests constantly under way at General Electric's turbine plant.

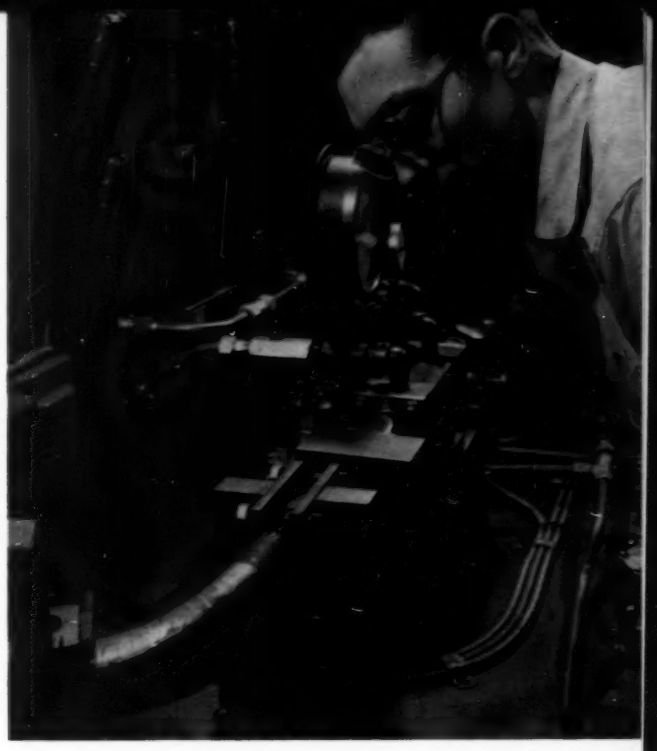


G-E APPLIED RESEARCH is typified by this full-size armature bar test. Here, General Electric engineers find out how well insulations can withstand the mechanical stresses caused by differential thermal expansion and contraction within an operating generator.

To simulate actual operation in this special 17½-foot core section, high currents are run through full-size stator conductors to build up heat; then are shut off while the apparatus is cooled by blowers. This procedure can reproduce ten years of anticipated operating stress cycles in just four months of testing. This important test provides an accurate means of evaluating both present insulation materials and new ones under development.



HIGH-VOLTAGE ENDURANCE of G-E insulation over long periods of time is graphically illustrated here. This record invites comparison with that of any other turbine-generator insulation in service today.



FLEXING TEST determines the insulation's ability to withstand bending caused by expansion and contraction or by short circuits. Here, a G-E engineer evaluates performance of the critical end portion of an armature bar.

EVERY GENERATOR leaving the factory has passed a series of searching high-potential tests. A sample bar, selected at random, is tested to failure. For quality control, each bar is separately subjected to voltage stresses of more than five times normal operating stress. When installed in the generator, the bar is again tested at voltages producing 3½ times normal operating stress. Immediately following generator running tests, windings are "hot high-potted" at operating temperatures, and finally tested at room temperature just prior to shipment.

Leader in Turbine-Generator Progress

GENERAL ELECTRIC

G-E engineers are developing new insulations for larger machines

In the picture above, a G-E development engineer is shown inspecting one of tomorrow's insulations now being developed in the Large Steam Turbine-Generator Department's Materials and Process laboratory. A special processing mill is being used to treat the new type insulating material. The rollers increase homogeneity and orient the structure for improved mechanical and electrical properties.

One of the new materials coming out of this applied research is Micapal, a mica-based synthetic insulation which shows marked improvements in dielectric strength, thermal conductivity, heat endurance, and mechanical strength. The first generator utilizing Micapal has been in commercial operation for more than two years.

Micapal and other insulations now under development will help continue General Electric's record of turbine-generator progress.

If you would like more information on G-E turbine-generator development, contact your nearest G-E Apparatus Sales Office, or write for Bulletin GER-1047, "Research and Development in the Field of Turbine-Generator Prime Movers in the General Electric Company." Large Steam Turbine-Generator Department, *General Electric Company, Schenectady 5, N.Y.*

254-28

Progress Is Our Most Important Product

GENERAL ELECTRIC

cure summer headaches...

Prevent and cure scale, corrosion and algae odors with Perolin air conditioning water treatments

Perolin Air Conditioning Water Treatments are as simple as they are effective.

Formet Crystals will not only prevent scale formation and corrosion, they will remove deposits that have formed in previously untreated systems. And treatment is automatic—just refill with Formet Crystals once a month!

Perolin Algae Preventative #905 comes in the form of briquettes which can simply be put into the sump or pan or applied with the Formet Crystals. (Briquettes should be added daily to treat make-up water.)

These are two of the most popular Perolin Treatments—adequate for most every condition and system. But there is a Perolin Treatment for *any* special condition which might arise.

It will pay you to investigate Perolin's simple, effective, inexpensive way to keep your Air Conditioning Water Systems free of scale, corrosion and algae odors. Perolin's Field Service Engineers will analyze your system and make recommendations without cost or obligation to you. And Perolin continues to provide Engineering Assistance to its customers without charge—

This coupon will save you many a summer headache—Use it today.

Perolin SINCE 1904

The PEROLIN COMPANY, Inc.

350 Fifth Avenue, New York 1, N. Y.

PC-105

THE PEROLIN CO., INC., 350 FIFTH AVENUE, NEW YORK 1, N. Y.

Gentlemen: Please send full details, without any obligation on my part, on Perolin Air Conditioning Water Treatments.

*I use*_____*gallons of make-up water per month.*

*I have a*_____*system with a*_____*ton capacity.*
BRAND NAME

*Name*_____ *Title*_____

*Company*_____

*Address*_____

*City*_____ *State*_____

NUCLEAR NEWS FROM ATOMICS INTERNATIONAL

Industry's First Private Research Reactor Now in Operation

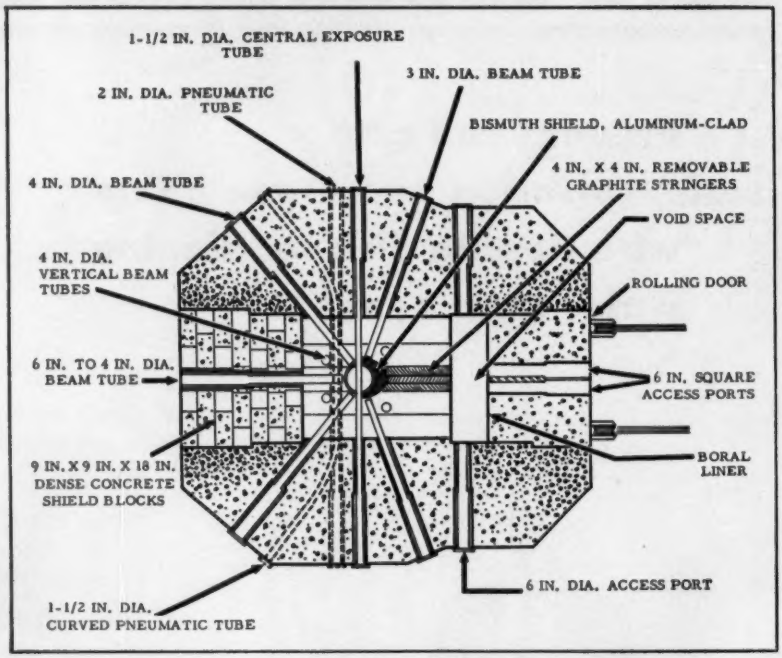
The Armour Research Foundation's nuclear reactor, located on the Illinois Institute of Technology Campus on State Street near Chicago's Loop, began operating early this spring. This marked the first time that private industry has had at its disposal a nuclear reactor expressly designed for industrial research.

Already under way at Armour are programs by participating companies, taking advantage of the revolutionary research techniques made possible by the new facility. The schedule includes allocation of reactor "time" for private studies, free of security restrictions. Areas of study include: food and drug processing; materials research – glass, ceramics, plastics, rubber, textiles, etc; petroleum, chemicals and other industrial materials and processes.

The Model L8 Armour reactor is of the homogeneous solution type, designed to operate at 50 KW and to produce a maximum thermal neutron flux of about 1.7×10^{12} neutrons/cm^2-sec at the center of the reactor core. Exposure facilities are provided through which the neutron flux is available in varying intensities for experimental purposes. Power level is controlled either manually or automatically by a vertical control-rod system. The reactor is safeguarded by a unique control system which "scrams," or automatically shuts down the reactor, if necessary.

One of several reactors produced by ATOMICS INTERNATIONAL, a Division of North American Aviation, Inc., the design and construction of the L8 Model is based on the company's 10 years' experience in the development of peaceful applications of nuclear energy. Other applications include a reactor designed for a prominent southern California university, specially adapted for cancer and other medical research; the important Sodium Reactor Experiment in the Santa Susana Mountains near Los Angeles, part of the AEC program to develop economical power from nuclear energy; plus development and design of a 75,000 KW sodium-graphite nuclear power plant.

ATOMICS INTERNATIONAL is a major reactor builder–experienced in the design, construction and operation of nuclear reactors for research and the production of power.


1-1/2 IN. DIA. CENTRAL EXPOSURE TUBE
3 IN. DIA. BEAM TUBE
2 IN. DIA. PNEUMATIC TUBE
BISMUTH SHIELD, ALUMINUM-CLAD
4 IN. X 4 IN. REMOVABLE GRAPHITE STRINGERS
4 IN. DIA. BEAM TUBE
VOID SPACE
4 IN. DIA. VERTICAL BEAM TUBES
ROLLING DOOR
6 IN. TO 4 IN. DIA. BEAM TUBE
6 IN. SQUARE ACCESS PORTS
BORAL LINER
9 IN. X 9 IN. X 18 IN. DENSE CONCRETE SHIELD BLOCKS
6 IN. DIA. ACCESS PORT
1-1/2 IN. DIA. CURVED PNEUMATIC TUBE

Reactor Plan View

ARMOUR RESEARCH REACTOR MODEL L8

Characteristics

Design Power	50 kw
Zero Power Critical Mass*	850 gm U^{235}
Maximum Thermal Neutron Flux	1.7×10^{12} n/cm^2-sec
Mass Coefficient of Reactivity*	0.03%/gm
Temperature Coefficient of Reactivity*	–0.029%/°C
Fuel Solution Temperature at 50 kw*	80° C
Excess Reactivity at 20° C, Zero Power*	3%
Reactivity Held in Control and Safety Rods*	8% (2% each rod)
H : U^{235} Atomic Ratio*	350
U^{235} Concentration*	75gm/liter
Power Density, Maximum	5.5 watt/cm^3
Power Density, Average	3.85 watt/cm^3

Approximate Value

Brief General Description—The reactor fuel is a light water solution of UO_2SO_4, enriched in U^{235}. This fuel is contained in a spherical stainless steel core tank, which is surrounded by a graphite reflector. The reactor is shielded with high density concrete (density 3.5 gm/cm^3) plus other selected materials. Fuel-handling, gas-handling and cooling systems are provided; also complete instrumentation and equipment are installed for remote operation and to provide automatic safety action.

Experimental Facilities—The experimental facilities include nine assorted beam tubes, 3" to 6" ID; straight and curved pneumatic tubes, 1½" and 2" ID; central exposure tube; horizontal thermal column 5' square, with four 6" access ports. In addition there are special exposure facilities which make use of the gamma activities in the reactor atmosphere.

If you are interested in any phase of our activities, ATOMICS INTERNATIONAL is staffed and equipped to help you. Please write: Applications Engineering Service, Dept. PW-N3, ATOMICS INTERNATIONAL, P. O. Box 309, Canoga Park, California. Cable address: ATOMICS.

ATOMICS INTERNATIONAL

A DIVISION OF NORTH AMERICAN AVIATION, INC.

PIONEERS IN THE CREATIVE USE OF THE ATOM

R.V.S.
Edward has the original and only complete line of carbon and stainless steel all-forged instrument valves. These features will save us money.
B. J. B.

ROCKWELL BUILT
Edward Valves

Bronze yoke bushing and fine stem threads wear longer, operate easier, adjust flow better.

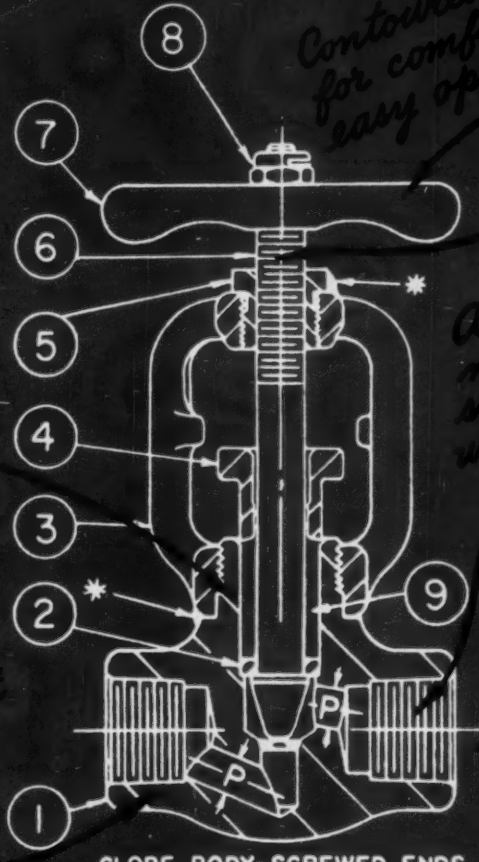
Contoured "T" handle for comfortable, easy operation.

Deep packing chamber high grade packing combine to minimize maintenance.

Drop forged heat-treated body provides strength and freedom from porosity without excess weight.

Accurately machined screwed or socket welding ends.

Let's have Edward supply all instrument valves and other steel valves on our new units.



GLOBE BODY-SCREWED ENDS

LIST OF MATERIAL
QUANTITIES ARE FOR ONE GLOBE OR ONE ANGLE VALVE
WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED THE LATEST REVISION APPLIES

PIECE NO.	NAME OF PIECE	NO. REQ'D	MATERIAL	SPECIFICATIONS	EDW. MS NO.
1	BODY	1	FORGED STEEL 0.30% MAX. C	A.I.S.I. C1029	114
2	JUNK RING	1	EVALLOY	A.S.T.M. A182 GRADE F6	212
3	YOKE	1	FORGED STEEL	A.S.T.M. A105 GRADE II	111
4	GLAND	1	FORGED STEEL EVALIZED	A.S.T.M. A105 GRADE II	111
5	YOKE BUSHING	1	BRONZE	A.S.T.M. B21	442
6	STEM	1	STAINLESS STEEL 13% CHROMIUM	A.I.S.I. TYPE 416	219
7	T-HANDLE	1	MALLEABLE IRON	A.S.T.M. A47 GRADE 32510	322
8	LOCK NUT	1	STEEL	COMMERCIAL	
9	PACKING		EVALPAK	HIGH TEMPERATURE PACKING	501
10	GLAND BOLT	2	FORGED STEEL EVALIZED	A.I.S.I. C1120	123
11	BOLT WASHER	2	STEEL		
12	BOLT NUT	2	STEEL-EVALIZED	A.S.T.M. A194 CLASS O	124
13	DISK	1	STAINLESS STEEL WITH STELLITED SEATING FACE	A.S.T.M. A193 GRADE B8F	257 481

EDWARD VALVES, INC.
SUBSIDIARY OF ROCKWELL MANUFACTURING CO.
EAST CHICAGO, INDIANA

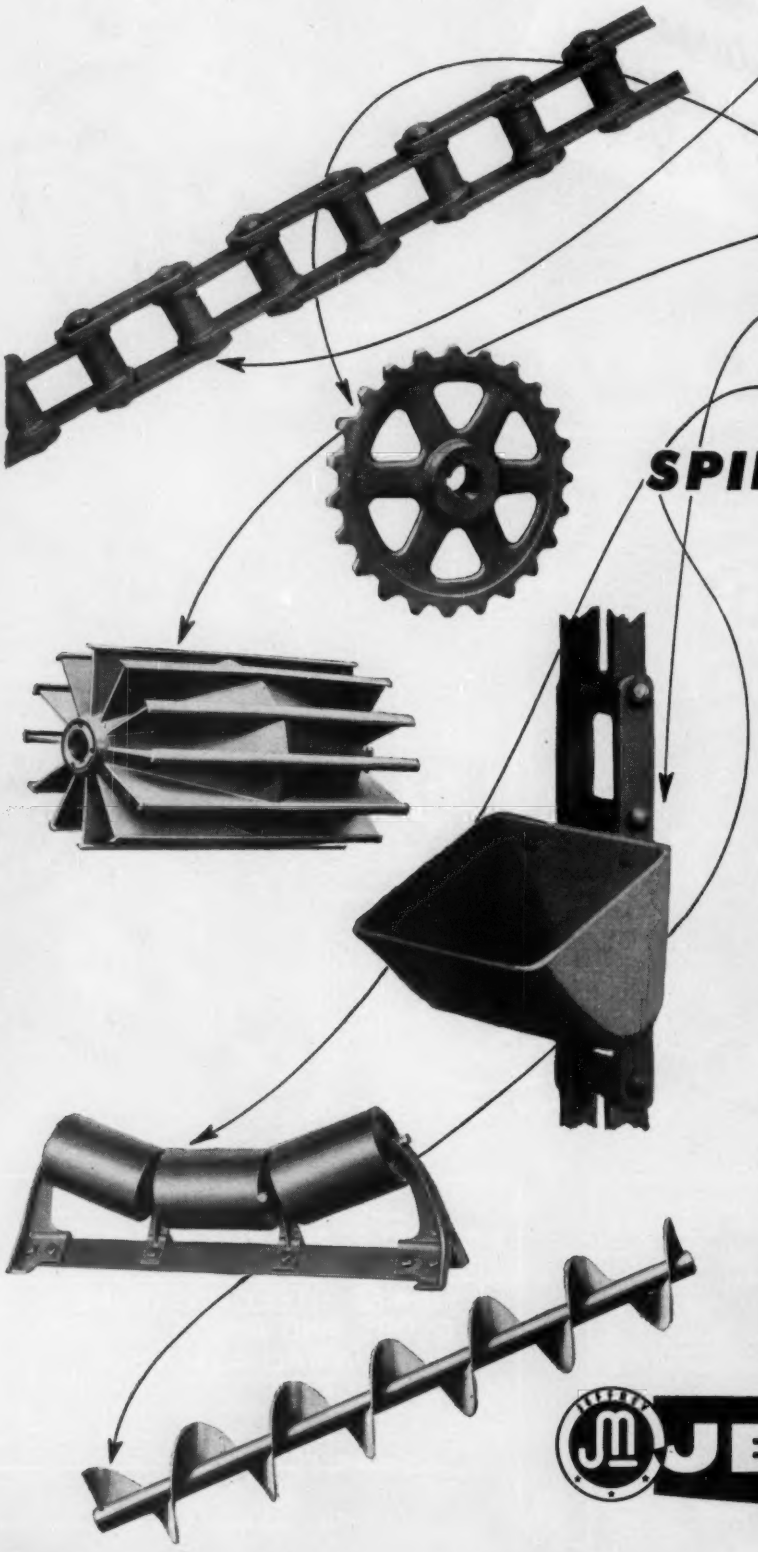
FORGED STEEL INSTRUMENT
GLOBE AND ANGLE VALVES
GENERAL ASSEMBLY

DRAWN: [illegible]
CHK'D: [illegible]
APP'D [illegible] DATE: 12-15-53

CE-3430

Edward builds Globe and Angle Stop, Non-Return, Check, Stop-Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

Specify **JEFFREY** when you replace



CHAINS
SPROCKETS
PULLEYS
BUCKETS
IDLERS
SPIRAL FLIGHTS

YOUR Jeffrey distributor can supply the units you need for replacing worn parts and modernizing old equipment. Your materials-handling and power-transmission machinery will give more efficient, economical operation when you use these time-tested, dependable products.

Jeffrey replacement parts have the same sound design as those used on original equipment. All are designed for maximum service. Materials and workmanship are the finest. Jeffrey District Offices and Distributors are located in all principal cities. The Jeffrey Manufacturing Co., Columbus 16, Ohio.

JEFFREY

CONVEYING · PROCESSING · MINING EQUIPMENT · TRANSMISSION MACHINERY · CONTRACT MANUFACTURING

J.B.-
These "Special" features are standard on 1500 and 2500 lb Edward Univalves.
R.Y.P.

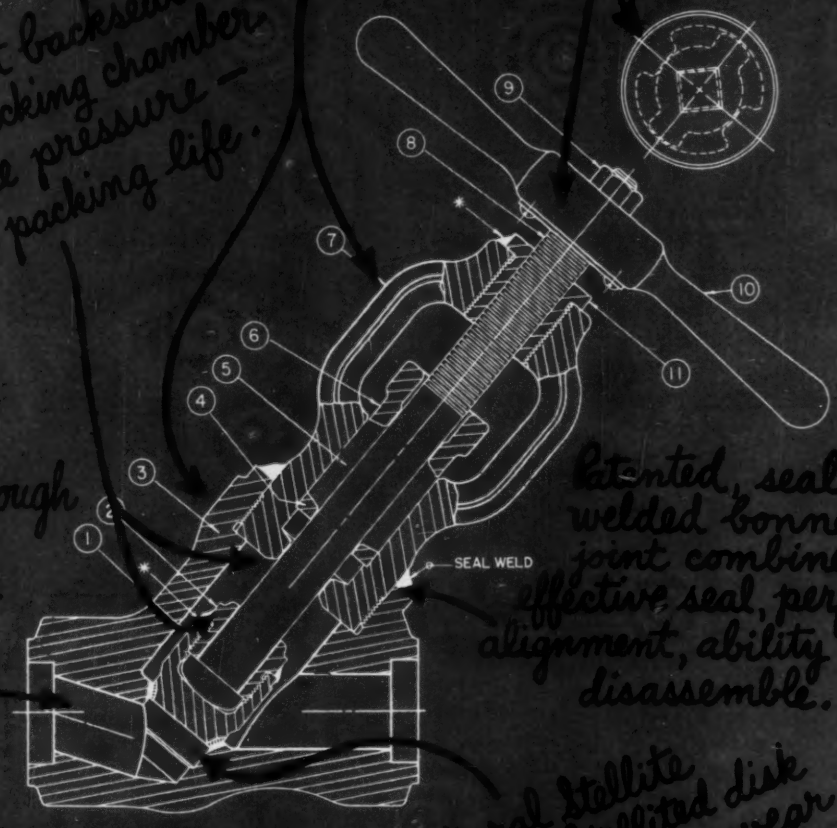
Impactor handle provides tight, effortless closing. No need for cheater.

Let's have Edward quote. Quality and performance are important

All forged construction— No porous castings here.

ROCKWELL BUILT
Edward Valves

Line contact backseat isolates packing chamber from line pressure — prolongs packing life.



Straight-through design minimizes erosive wear due to turbulent flow — extends life.

Patented, seal-welded bonnet joint combines effective seal, perfect alignment, ability to disassemble.

Integral Stellite seat - Stellited disk resist wear.

LIST OF MATERIAL
QUANTITIES ARE FOR ONE GLOBE OR ONE ANGLE VALVE
WHERE A.S.T.M. SPECIFICATIONS ARE INDICATED THE LATEST REVISION APPLIES

PIECE NO.	NAME OF PIECE	NO. REQ'D.	MATERIAL	SPECIFICATIONS	EDWARD MS NO.
1	DISK	1	FORGED STEEL	A.S.T.M.A182 GRADE F11	227
2	DISK NUT	1	EVALLOY	A.S.T.M.A182 GRADE F6	212
3	BODY	1	FORGED ALLOY STEEL	A.S.T.M.A182 GRADE F11 (b)	227
				A.S.T.M.A182 GRADE F22 (c)	230
4	JUNK RING	1	STEEL-EVALIZED	A.I.S.I. C1120	123
5	PACKING RINGS		EVALPAK	HIGH TEMPERATURE PACKING	501
6	GLAND	1	FORGED STEEL	A.S.T.M.A105 GRADE II	111
7	BONNET	1	FORGED ALLOY STEEL	A.S.T.M.A182 GRADE F11 (b)	227
				A.S.T.M.A182 GRADE F22 (c)	230
8	STEM	1	EVALLOY	A.I.S.I. GRADE 416	261
9	STEM NUT	1	STEEL	A.S.T.M.A194 CLASS 1 OR 2	124
10	IMPACTOR HANDLE	1	MALLEABLE IRON	A.S.T.M. A47 GRADE 32510	322
11	YOKE BUSHING	1	BRONZE	A.S.T.M. B148 GRADE 9B HT	432
12	GLAND BOLT NUT	2	STEEL	A.S.T.M.A194 CLASS 1 OR 2	124
13	GLAND STUD	2	STEEL	A.S.T.M.A193 GRADE B7	209
14	GLAND BOLT LOCKNUTS	4	STEEL	A.S.T.M.A194 CLASS 1 OR 2	124

EDWARD VALVES, INC.
SUBSIDIARY OF ROCKWELL MANUFACTURING CO.
EAST CHICAGO, INDIANA

FORGED STEEL UNIVALVES
GENERAL ASSEMBLY
FIG.-3924 SIZES ½, ¾, 1, 1¼, 1½, 2

DRAWN: A. Dubats
CHK'D: J. Piet
APP'D: [illegible] DATE: [illegible]

DRAWING NO. AE-3593-1

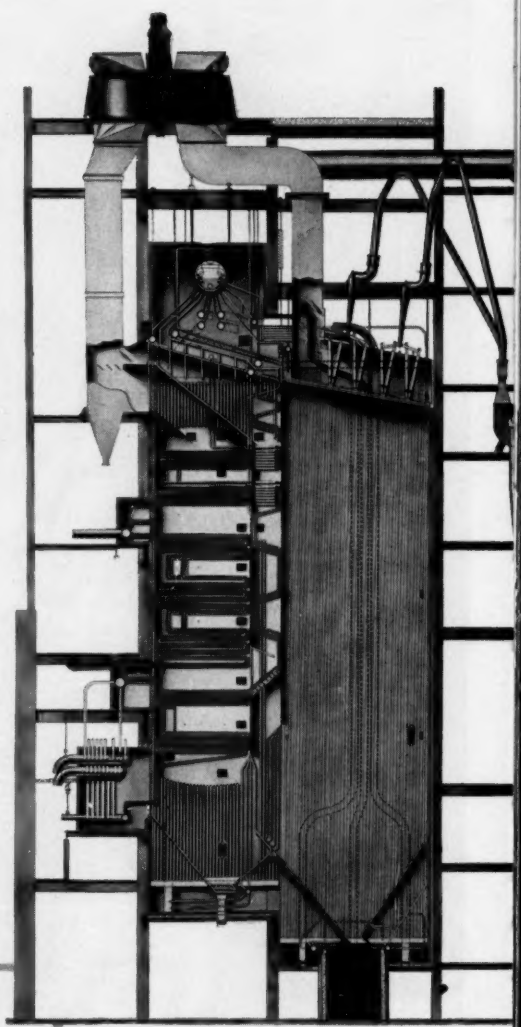
Edward builds Globe and Angle Stop, Non-Return, Check, Stop-Check, Gate, Blow-Off, Mudline, Relief, Hydraulic, Instrument, Gage, and Special Valves and Strainers.

Now on the Line at Duquesne Light

1,060,000 lb/hr

Reheat Steam Generator by FW

Sixth Foster Wheeler Steam Generator at Phillips Station marks latest expansion of Duquesne system ... an expansion that will soon include atomic power at Shippingport, where FW Steam Generators will also serve



The capacity of the Phillips Station of Duquesne Light Company was increased by 156,200 kw when Unit No. 4 went on the line in January 1956. This, the largest and most efficient unit in the Duquesne system, is served by the 1,060,000 lb/hr Foster Wheeler reheat-type steam generator shown at the right.

The addition of Unit No. 4 brings total capability of Phillips Station to 382,000 kw. *All four* of these units are powered by Foster Wheeler steam generators — a tribute to customer satisfaction that dates back to the first installation in 1942.

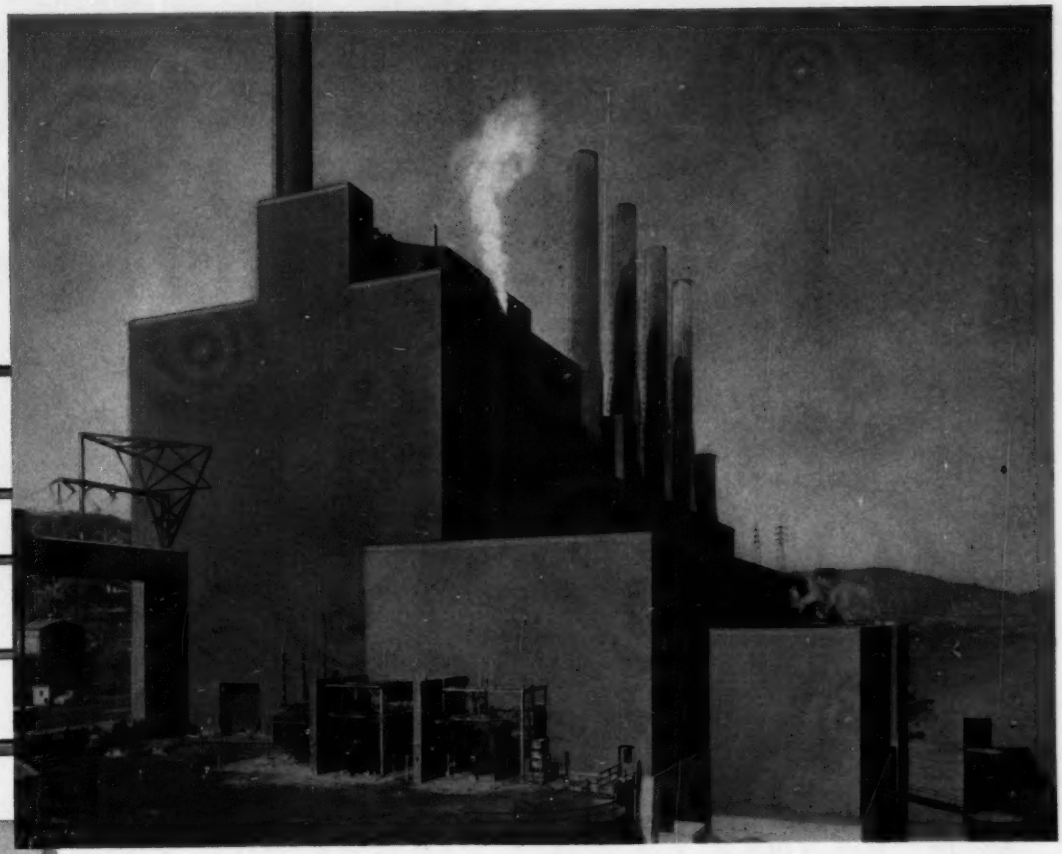
In the nation's first full scale atomic power plant, now under construction at Shippingport, Pa. and scheduled for completion in 1957, two Foster Wheeler steam generators (heat exchangers) will be used to convert heat from the nuclear reactor to 600 psi steam.

Whatever your Power Plant requirements — from coal or oil firing to nuclear energy — heat engineering by Foster Wheeler means efficient and dependable steam generation at low overall cost. For further information, write to *Foster Wheeler Corporation, 165 Broadway, New York 6, New York.*

FW STEAM GENERATORS AT DUQUESNE'S PHILLIPS STATION

1942 — TWO twin-furnace units, 500,000 lb/hr, 900 psi, 900F
1949 — ONE twin-furnace unit, 700,000 lb/hr, 900 psi, 900F
1950 — TWO twin-furnace units, 700,000 lb/hr 900 psi, 900F
1956 — ONE divided-furnace, reheat unit, 1,060,000 lb/hr, 1850 psi, 1000/1000F

Company's Phillips Station:



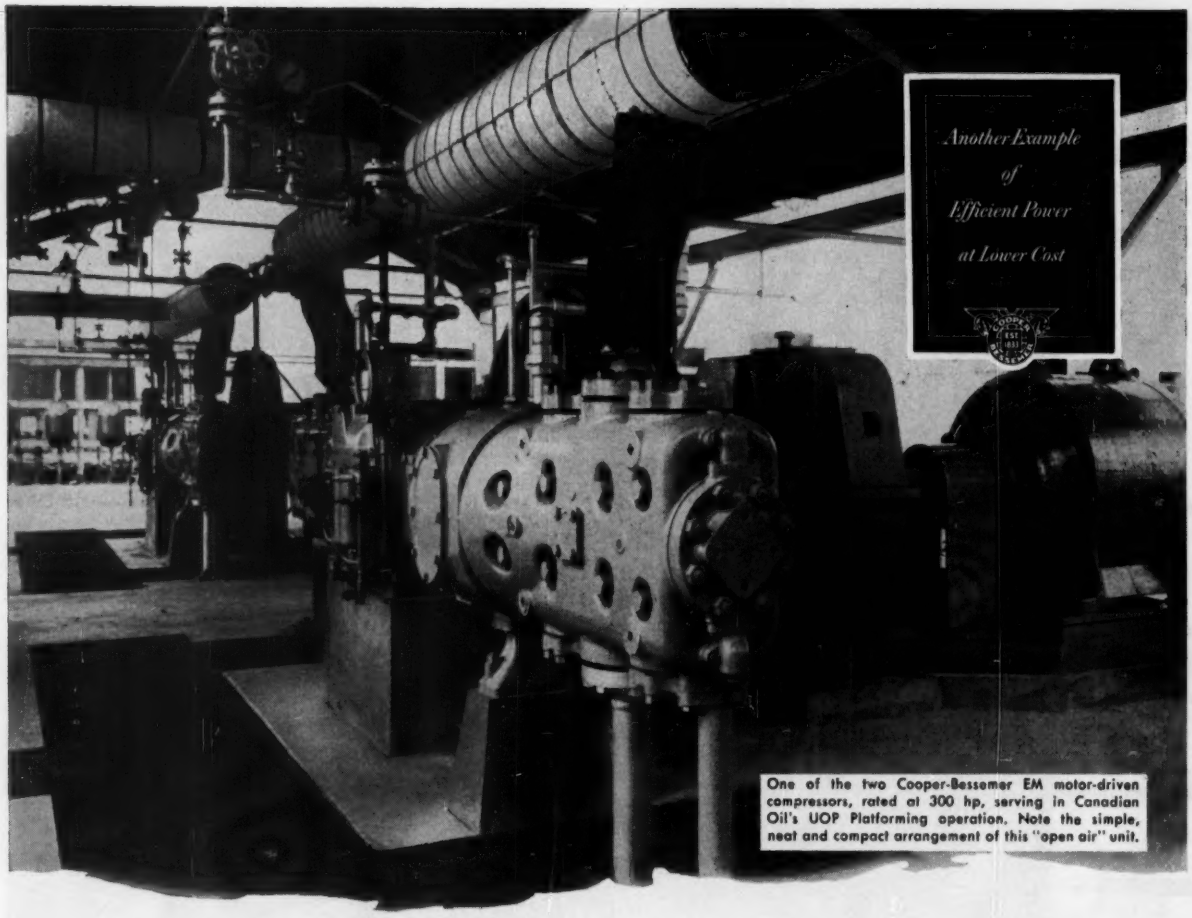
The FW steam generator for Unit No. 4 at the Phillips Station above is shown in cross section at the left. It delivers 1,060,000 lb steam per hour at 1,850 psi, 1,000F at the superheater outlet and 1,000 F reheat. The primary steam temperature is controlled at 1,000F over a load range from 689,000 to 1,060,000 lb/hr by spray control. Reheat temperature is also controlled at 1,000F over the same load range by gas by-pass.

This 44-ft wide furnace is vertically fired by 12 FW intertube burners located in the roof. The furnace is divided into three firing cells; the front, side and division walls containing waterwall surface while the rear wall is of radiant superheater surface. Furnace exit gases are divided into two passes, with convection superheater, convection reheater, and bare-tube economizer in the main pass, and convection superheater and extended-surface economizer in the by-pass section.

Coal for this 1,060,000 lb/hr unit is pulverized by two of the largest ball mills ever installed. These Foster Wheeler D-8D suction-type ball mills have a capacity of 67,000 lb of coal per hour, ground to a fineness of not less than 75% through a 200 mesh sieve and not less than 99% through a 50 mesh sieve. The pulverized coal-air stream is drawn from both ends of the double-ended mills and piped to four distributors near the top of the furnace, each distributor dividing it three ways so that each pulverizer exhaust feeds a burner in each of the three furnace cells. This assures a very even distribution of heat across the furnace.

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.



One of the two Cooper-Bessemer EM motor-driven compressors, rated at 300 hp, serving in Canadian Oil's UOP Platforming operation. Note the simple, neat and compact arrangement of this "open air" unit.

With CANADIAN OIL'S PLATFORMING UNIT... a new high in compressor efficiency for high octane gasoline

COOPER-BESSEMER 2-cylinder motor-driven M-Line compressors efficiently recycle hydrogen for the UOP Platforming unit in the Sarnia, Ontario, refinery of Canadian Oil Refineries, Ltd.

Cooper-Bessemer developed compressors with non-lubricated cylinders have permitted Canadian Oil Refineries to run its Platforming unit thousands of hours without any possibility of contaminating the recycle gas with lubricating oil.

Canadian Oil's Platformer is charging nearly 3800 barrels per stream day, and producing high yields of gasoline with an octane number reaching well into the 90's. In this process, Cooper-Bessemer EM's continue to play a vital and dependable role in the production of high octane gasoline.

If you are considering UOP Platforming, or compressor additions of virtually any type, Cooper-Bessemer offers more than a century of reliable compressor building experience. Contact our nearest office for detailed information.

MOUNT VERNON, OHIO

COOPER-BESSEMER

GROVE CITY, PENNA.

New York City • Seattle, Wash. • Bradford, Pa. • Chicago, Ill. Houston, Dallas, Greggton, Pampa and Odessa, Texas Washington, D. C. • Shreveport, La. • San Francisco, Los Angeles, Calif. • St. Louis, Mo. • Gloucester, Mass. • New Orleans, La. • Tulsa, Okla. • Cooper-Bessemer of Canada Ltd., Edmonton, Alberta—Halifax, Nova Scotia.

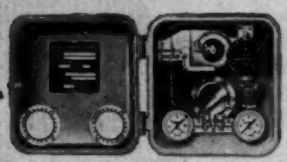
DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS

FISHER®
LEVEL-TROL

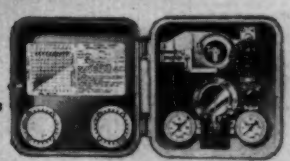
The Answer to Your Liquid Level Needs

TYPE 259B—Level-Trol cage unit with 2" 600 lb. flanged top and bottom equalizing connections (F-1).

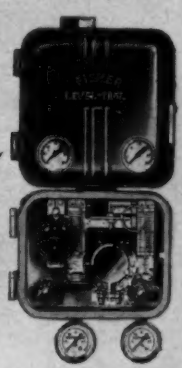
TYPE 2500—proportional pilot for general liquid level control applications.



TYPE 2500T — Level-Trol pilot used as pneumatic level transmitter.



TYPE 2500C—pilot with level indicator. Indicator available on all style Level-Trol pilots.



TYPE 2500 — 2516 dual Level-Trol pilot consisting of Type 2500 for remote level-indication or recording and Type 2516 controller with proportional and reset response.

The wide variety of pilots available for mounting on the Level-Trol gives further evidence of the Level-Trol's ability to handle practically any liquid level, interface level, or specific gravity control or indication problem.

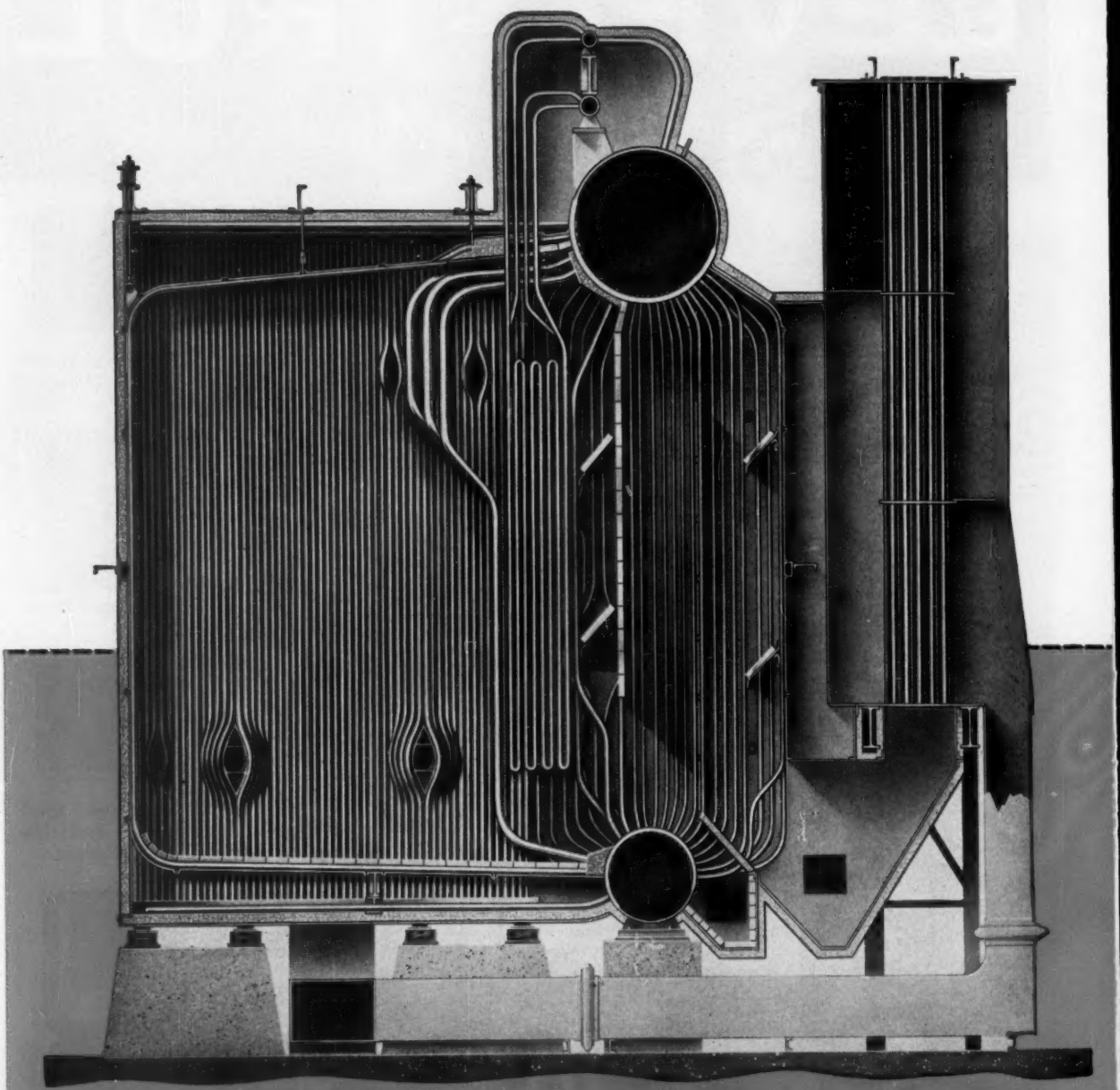
FISHER GOVERNOR COMPANY

MARSHALLTOWN, IOWA • WOODSTOCK, ONTARIO

WORLD LEADER IN RESEARCH FOR BETTER PRESSURE AND LIQUID LEVEL CONTROL

FISHER Since 1880

THE VU-55...



SPECIFICATIONS

Sizes—Five sizes ranging from 50,000 to 120,000 lb of steam per hr.
Pressures—250 up to 750 psi (all sizes)
Superheat—as required up to 300° F
Fuels—oil or gas, pressure fired
Heat Recovery—Tubular or Regenerative Air Preheater

AN OUTSTANDING BOILER BUY FOR CAPACITIES FROM 50,000 TO 120,000 LB. OF STEAM PER HOUR!

The VU-55 – a development of Combustion's basic Vertical Unit design—offers features never before available in a boiler of its capacity range. If your steam needs call for a unit in the 50,000 to 120,000-lb class, you will find it worth while to consider the economic and operating advantages assured by these VU-55 features:

TANGENTIAL FIRING. More than 20 years of application experience have established the exceptional advantages of tangential firing, illustrated and briefly described below. About 90 percent of Combustion's large utility installations use this advanced method of firing.

DOUBLE WALL, PRESSURIZED CASING. The latest development in casing construction for pressure firing of boilers in the size class of the VU-55, this casing as illustrated and described below, is designed to assure life-time tightness with minimum heat loss. Pressure firing permits the elimination of an induced draft fan with its attendant operating and maintenance costs.

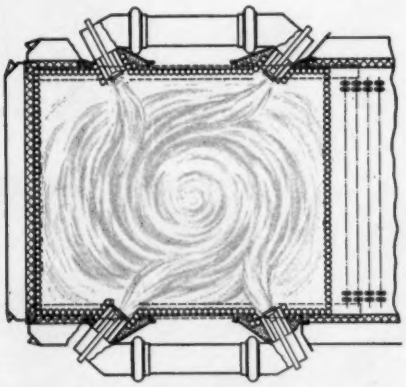
TANGENT FURNACE TUBES. The VU-55's furnace tube arrangement provides complete heat-absorbing, water-cooled protection on all furnace walls. Furnace maintenance is minimized, refractory expense is eliminated, heat absorption rates per sq ft are higher.

SIMPLIFIED ERECTION. Shop assembly of furnace wall panels and boiler screen tubes saves time and money in handling, transportation and erection.

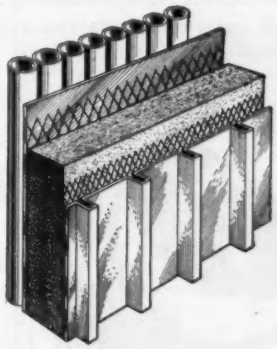
HIGH STEAM QUALITY. Equipped with a large (60-in.) steam drum, the VU-55 has generous water capacity and steam reservoir space. C-E drum internals assure high quality steam at all ratings.

STREAMLINED EXTERIOR. The over-all appearance of the VU-55 reflects the efforts of its designers to achieve a completely unobstructed casing, while retaining adequate access wherever required and every facility for convenient operation. There are no outside downcomer tubes, and ducts from air heater to burners are beneath the furnace floor.

Your request for further information on the VU-55 Boiler will receive prompt attention.



PLAN VIEW OF FURNACE showing arrangement of burners for tangential firing. Flame streams from the four burners impinge upon one another at high velocity, creating a turbulence unattainable by any other method of firing. The result is rapid and complete combustion. As the gases spiral upward, they sweep all furnace heating surfaces, assuring a high rate of heat absorption.



PERSPECTIVE OF FURNACE WALL. Construction consists of tangent tubes backed up successively by welded steel panels, 4 inches of high quality insulating material and an outer steel casing formed as shown to provide adequately for expansion and assure ample strength. Low heat loss and the tightness required for pressure firing are assured by this double-wall construction.

COMBUSTION ENGINEERING

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.
CANADA: COMBUSTION ENGINEERING-SUPERHEATER LTD.

B-938

STEAM GENERATING UNITS; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; HOME HEATING AND COOLING UNITS; DOMESTIC WATER HEATERS; SOIL PIPE

This "OGRE" can ruin a hot underground piping system that is turned on and off!
Let's look beyond just the initial cost of installing an underground piping system!
Consider for a moment how this system, once installed, will react to the thermal shock of turning it on and off (and what system isn't turned on and off occasionally). Unless the system is inherently capable of withstanding the shock of on and off service . . . that's when the "Ogre of Corrosion" swiftly becomes a real threat . . . and it costs you money!
Ask your Ric-wil representative to explain how a Ric-wil system protects you against on and off thermal shock.
RIC-WIL
Write for the NEW Ric-wil Catalog or phone your Ric-wil representative for a copy.
Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency
RIC-WIL INCORPORATED
PREFABRICATED INSULATED PIPING SYSTEMS
BARBERTON, OHIO
Representatives in Principal Cities

TURBINE AND DIESEL LUBRICANT GUIDE

CITIES SERVICE TURBINE OILS

Manufactured from the highest quality, solvent refined stocks, these oils have high viscosity index, excellent heat resistance. They are chemically fortified to prevent oxidation, rust, and foaming, permit smoother operation.

PACEMAKER 150-T

Recommended for pressure-circulation systems of direct-connected steam turbines, and for the bearings of turbo-generators where pressure-circulation of the oil is employed.

PACEMAKER 300-T

For use in the lubrication of steam turbines with single reduction gear units. Also for the lubrication of high-speed, ring-oiled, auxiliary turbines, where operating temperatures are not above 200°F.

PACEMAKER 400-T

Recommended for the lubrication of propulsion turbine units on naval and commercial vessels, in pressure-circulation systems.

PACEMAKER 500-T

Suitable for the lubrication of ring-oiled bearings of auxiliary turbines where operating conditions require an oil of heavier body than Pacemaker 300-T. Also recommended for use in separately lubricated turbine gear reduction units.

PACEMAKER 750-T

Recommended for the lubrication of high-speed, ring-oiled, auxiliary turbines, where operating temperatures are in excess of 200°F., and use of a heavier bodied oil is required.

CITIES SERVICE DIESEL OILS

Made in the world's most modern lubricating oil refinery at Lake Charles, Louisiana, Cities Service Diesel Oils are blended from highest quality, high V.I. mineral oils and fortified with specially developed additives. There's a Cities Service Diesel Oil tailored for top performance in every type of diesel operation.

D-C 300 SERIES

These oils are designed to fully conform to Military Specification MIL-L-2104A. Made from the finest base oils, they are strongly fortified against oxidation and corrosion. They have the necessary detergent-dispersant properties to insure superior lubrication performance in high speed Diesel engines operating under heavy duty service.

Recommended for service DG under A.P.I. classification system.

D-C 100 SERIES

These oils are designed to conform to U. S. Army Specification 2-104B (Supplemental List 1). They are also known as Superior Lubricants Series 1 and are intended for more severe service than the D-C 300 Series Oils. Particularly recommended for the lubrication of medium and high-speed Diesel engines using lower quality fuels.

Recommended for service DM under A.P.I. classification system.

D-C 500 SERIES

These oils meet the requirements of The Caterpillar Tractor Company for a "Superior Lubricant (Series 3)". They have the highest level of detergent-dispersant action with maximum oxidation and corrosion protection to assure reliable operation of Diesel engines under most severe service conditions or where low quality fuels of very high sulphur content are used.

Recommended for service DS under A.P.I. classification system.

PACEMAKER SERIES

The new Pacemaker line of Diesel engine oils is made from the same high quality base oils as are the Pacemaker T Series, and contains similar additives, but in lesser amounts. These oils are adaptable for use in many low and medium speed stationary engines operating under conditions which would not require the use of heavier fortified oils, such as the Pacemaker T Oils.

PACEMAKER T SERIES

These are medium duty, high grade, high V.I. oils fortified against oxidation, rust and foam. Admirably suited for slow and medium speed engines employing the dry sump system of lubrication and operating under conditions where the service is not severe enough to benefit from a full heavy duty oil.

NEPTUNE 9000 SERIES

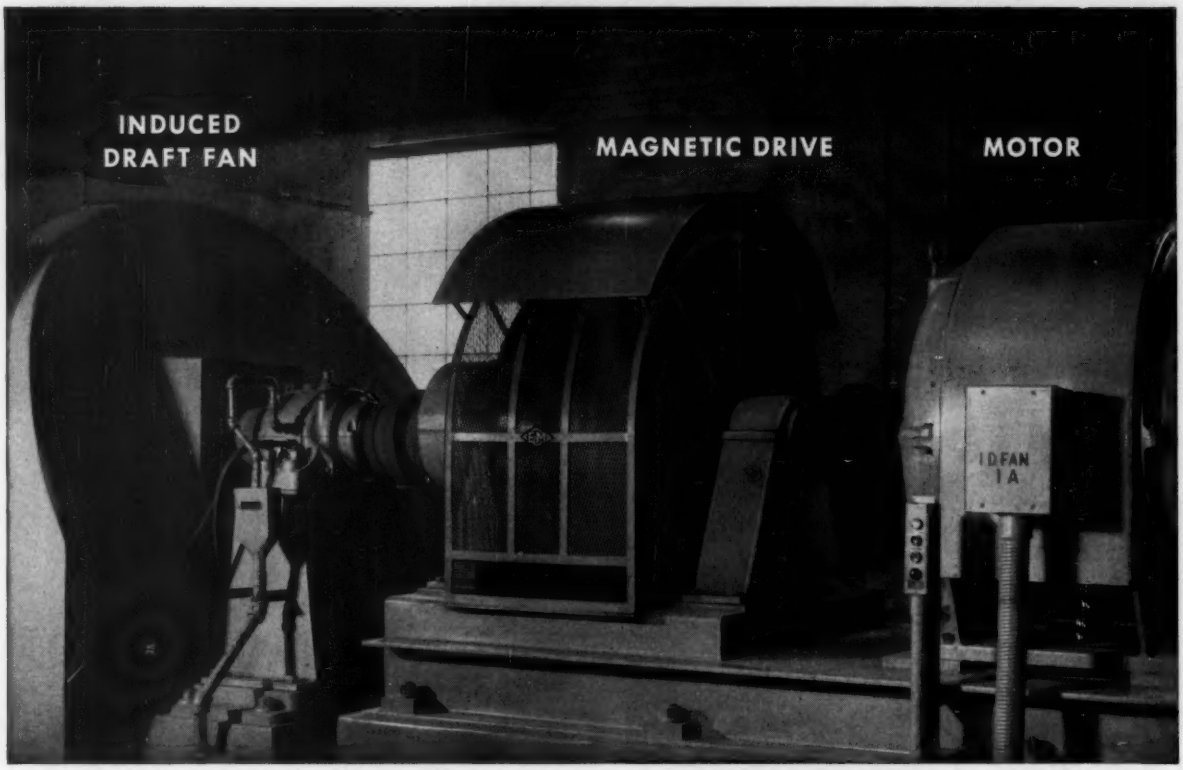
Designed specifically for lubrication of marine-type Diesel engines, both military and commercial.

Neptune 9000 Series Oils are made from high quality, high V.I. solvent refined stocks and are strongly fortified against oxidation and corrosion. They are specially inhibited against silver alloy bearing corrosion and have the necessary detergent-dispersant properties to give maximum performance under severe operating conditions.

These oils conform to the requirements of Military Specification MIL-L-900 C (SHIPS) for marine Diesel engine lubrication.

CITIES SERVICE

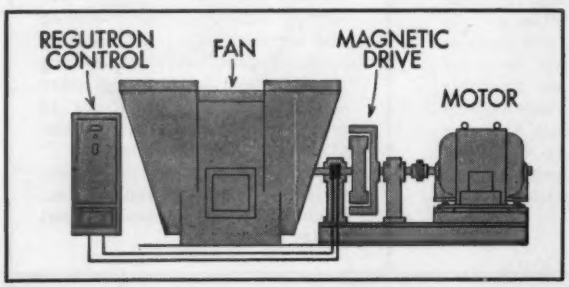
QUALITY PETROLEUM PRODUCTS



Now 20 E-M Magnetic Drives for Potomac Electric Power Company

● The clean, compact E-M Magnetic Drive above gives adjustable speed for an induced draft fan at the Potomac Electric Power Company Buzzard Point plant, Washington, D.C. This Drive is rated at 550 hp, 850/90 rpm. The first Magnetic Drives were installed by this large, rapidly growing utility in 1941.

These E-M Magnetic Drives transmit torque electromagnetically from constant-speed a-c drive motors to vary the speed of the fans. The Magnetic Drive responds precisely to the speed dictated by the automatic combustion control.



E-M MAGNETIC DRIVE SYSTEM for induced draft fan speed control consists of a constant-speed motor, the Magnetic Drive, and the E-M "Regutron" Speed Control. Operating speed of the "magnet" coupled to the fan shaft is held at the desired value by the "Regutron" which supplies d-c excitation to the "magnet" in accordance with the demands of the combustion control system.

Among the advantages of Magnetic Drive speed control you will find:

1. **Savings in Driving Power.** Because fan operating speed is no more than required, drive power is used most sparingly.
2. **Reduced Blade Erosion.** When boiler load is reduced and fan speed is reduced accordingly, "sand blasting" effect on the blades by airborne particles is reduced to a minimum.
3. **Precise Control of Air Flow.** The E-M Magnetic Drive maintains fan speed to within plus or minus *one-half percent!*
4. **Easy and Economical Maintenance.** The Drive and its control contain few moving parts. It is simple to understand and requires little maintenance. No auxiliary cooling equipment needed.

Ask your nearest E-M sales engineer for more facts and figures on this simple, economical method of driving draft fans. And write the factory for E-M Publication No. 1107 containing pictures and data on typical Magnetic Drive applications.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

4400-TPA-2151

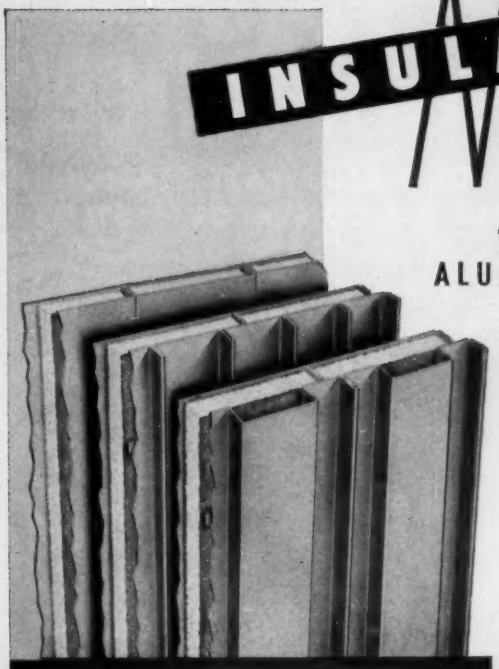
E-M

Magnetic Drives **MAKE DRAFT FANS DO EXACTLY WHAT YOU WANT THEM TO**

INSULATED METAL WALLS

for POWER and STEAM GENERATING PLANTS

ALUMINUM, STAINLESS or GALVANIZED STEEL



FLUSH, RIBBED, or FLUTED
Over-all "U" Factor of Various Types is Equivalent to or Better than Conventional 16" Masonry Wall

In today's modern powerhouses, Insulated Metal Curtain Walls have become the accepted construction. For these necessarily-high structures, light-weight, permanent metal curtain walls offer savings in both cost and construction time that cannot be disregarded . . . in some structures the savings amount to one-half the cost of masonry walls. In recent years, sixty-seven powerhouses have been constructed with Mahon Insulated Metal Walls alone . . . bright metal—aluminum or stainless steel—has been employed for all exterior surfaces or in combination with brick and other materials to produce structures of attractive and distinctive appearance. The powerhouse below is an excellent example. Mahon Insulated Metal Walls are selected in most cases because: (1) Vertical joints between exterior wall plates are invisible—symmetry of pattern is uninterrupted across the wall surface. (2) Walls can be field-constructed up to sixty feet in height without a horizontal joint. These two features which, from an appearance standpoint, are extremely important in powerhouses where high expanses of unbroken wall surface are common, were engineered into Mahon walls to provide a wall surface without unsightly joints. You, too, will want these "better-look" features in the metal curtain wall you select for your next project. See Sweet's Files for information or write for Catalog W-56.

THE R. C. MAHON COMPANY • Detroit 34, Michigan

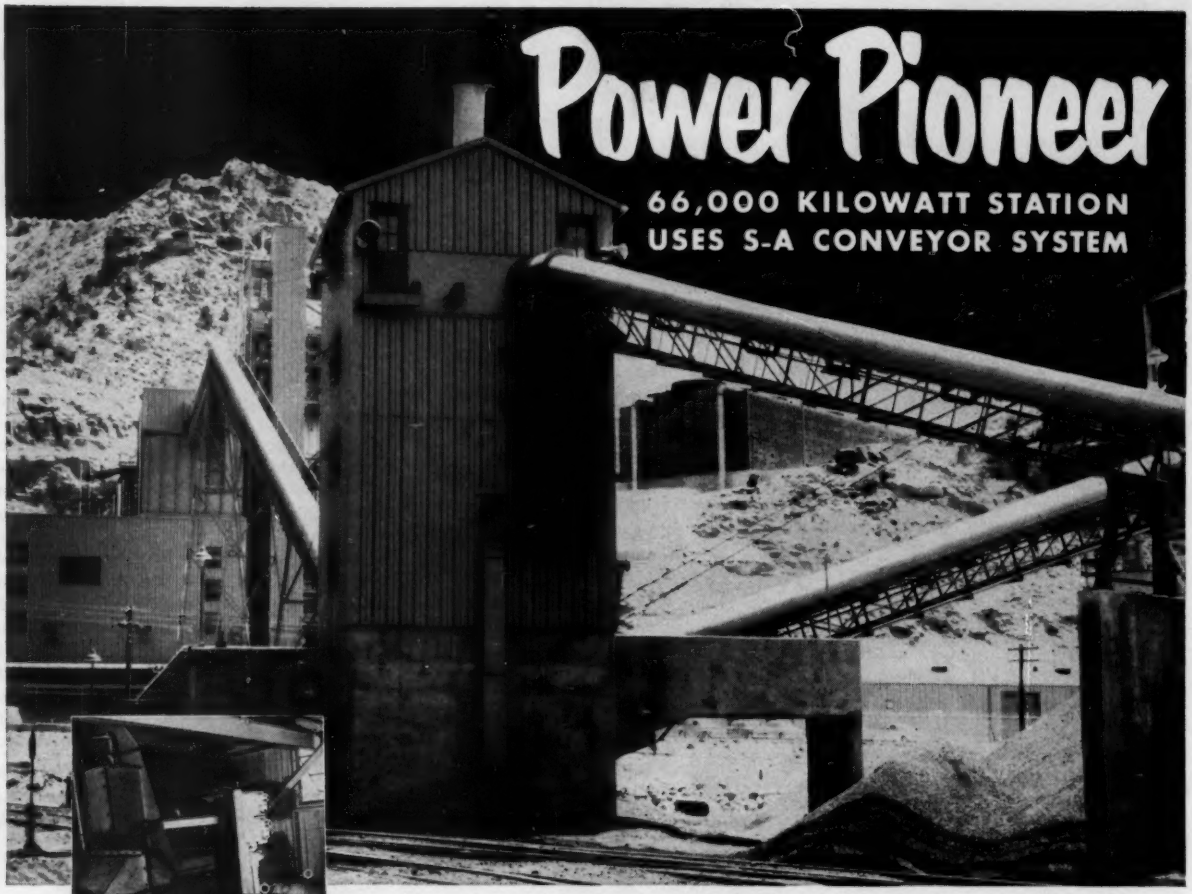
Sales-Engineering Offices in Detroit, New York and Chicago • Representatives in Principal Cities

Manufacturers of Insulated Metal Walls and Wall Panels, M-Floors (Electrified Cel-Beam Floor Systems), Permanent Steel Floor Forms, Steel Roof Deck and Long Span M-Decks, Rolling Steel Doors, Grilles, and Underwriters' Labeled Automatic Rolling Steel Fire Doors and Fire Shutters.

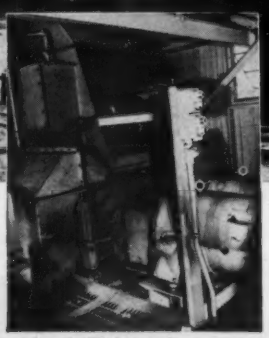
MAHON

Power Pioneer

66,000 KILOWATT STATION USES S-A CONVEYOR SYSTEM

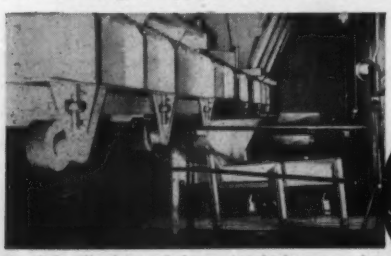


GENERAL VIEW OF CONVEYOR GALLERIES RUNNING TO AND FROM CRUSHER HOUSE



Double rotor knittel crusher processes 200 tons per hr. Coal is broken up by rotating twin sector gangs and dropped through size classifying grate.

Traveling tripper discharges 24 inch conveyor belt at any point into coal bunkers at either side of conveyor. Tripper covers a 55 ft. run.



Coal is discharged from track hoppers by twin S-A reciprocating plate feeders. Coal is moved underground at a rate of 200 tons per hour. Feeders are 40 in. wide by 14 ft. long.

The first steam-electric station to serve advancing power demands in the area, this Utah Power and Light Company plant depends for coal delivery on a conveyor system built and engineered by Stephens-Adamson. Tremendously rich in coal and other mineral deposits, the barren country around Price, Utah is destined to serve one of the nation's future great industrial centers.

As usual, S-A custom designing has been instrumental in effecting initial cost savings. Routine maintenance has been made easy by "in the open" construction.

Coal handling problems get swift and expert treatment by S-A engineers. They are capable of complete plant layout or are available to work in cooperation with your plant engineer.

More than half a century of designing and manufacturing experience is why it will pay you to convey the S-A way. We know how to move bulk materials at lowest possible cost per ton. From our very complete line of manufactured products we can supply the smallest or largest requirements.

STEPHENS-ADAMSON MFG. CO.

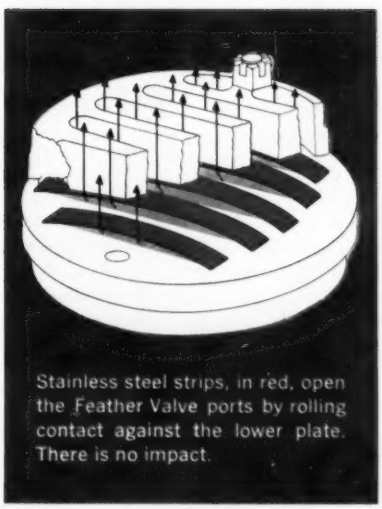
5 Ridgeway Ave., Aurora, Ill.—Los Angeles, Calif.—Belleville, Ontario.

ENGINEERING DIVISION
Designers and manufacturers of all types of bulk materials conveying systems.

STANDARD PRODUCTS DIVISION
A complete line of conveyor accessories—centrifugal loaders—car pullers—bin level controls, etc.

SEALMASTER DIVISION
A full line of industrial ball bearing units available in both standard and special housings.

This compressor valve works with no impact for longer life, best efficiency



Stainless steel strips, in red, open the Feather Valve ports by rolling contact against the lower plate. There is no impact.

The Feather* Valve is the lightest, simplest, quietest compressor valve ever developed. Flexible strips of stainless steel open and close the valve ports with a gentle rolling contact. There is no destructive impact . . . even when the valve is operating as fast as forty times a second.

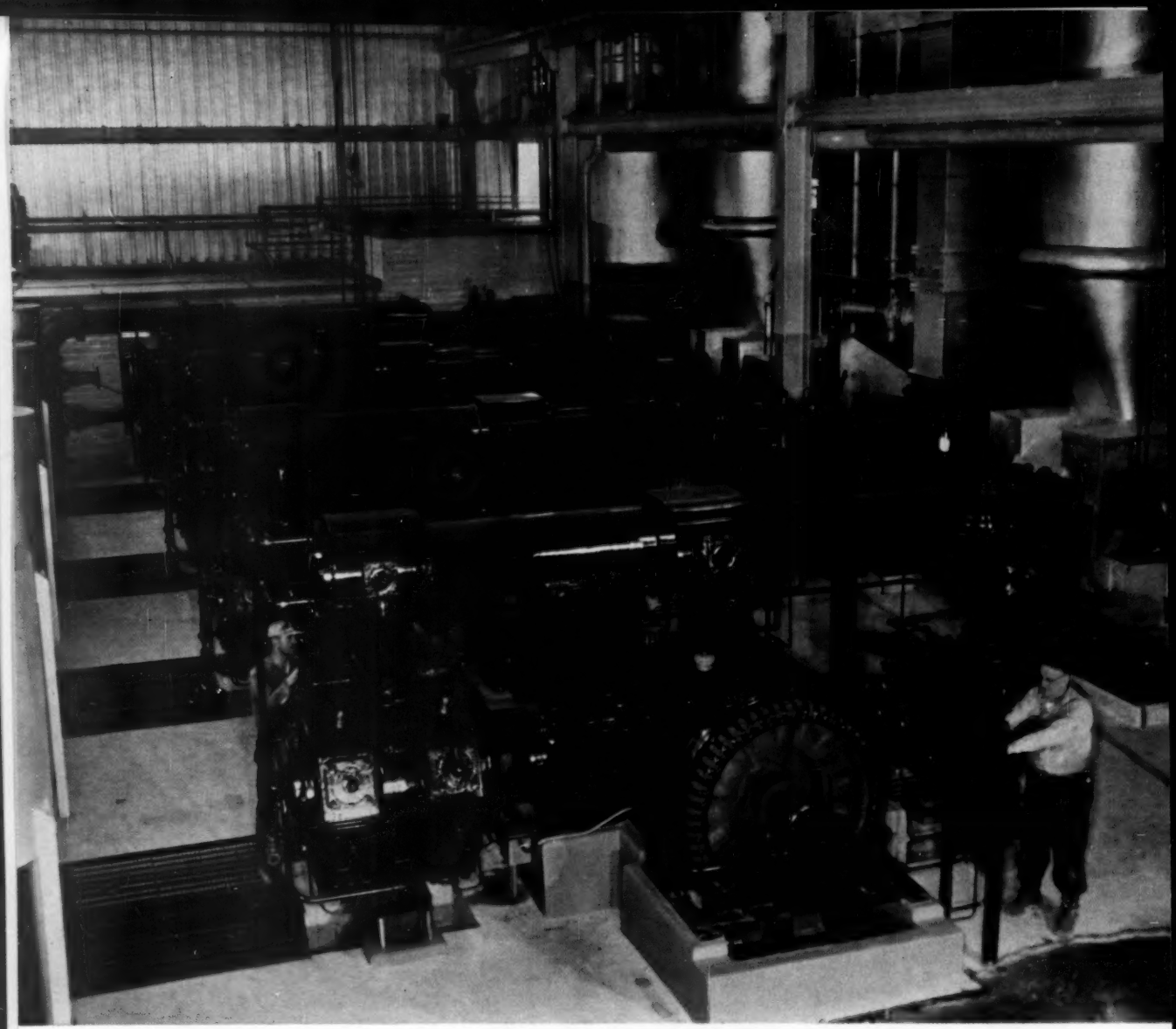
This lack of impact assures long life and negligible maintenance. The valve itself is all but indestructible. Absence of buffer plates and cushioning devices give it extreme simplicity.

The Feather Valve is quiet and reliable because of its lightness and tight contact seating. Valve action is very sharp. There is virtually no slip or back flow. As a result, you get minimum valve loss and use minimum power.

To get the utmost in performance, be sure you specify Worthington when you buy your next compressor. Worthington Corporation, Harrison, N. J. K.6.2

WORTHINGTON

*Reg. U. S. Pat. Off.



You get permanent alignment with these balanced opposed compressors

To assure permanent alignment, mated steel tie bars—machined for precise fit—are locked over each main bearing.

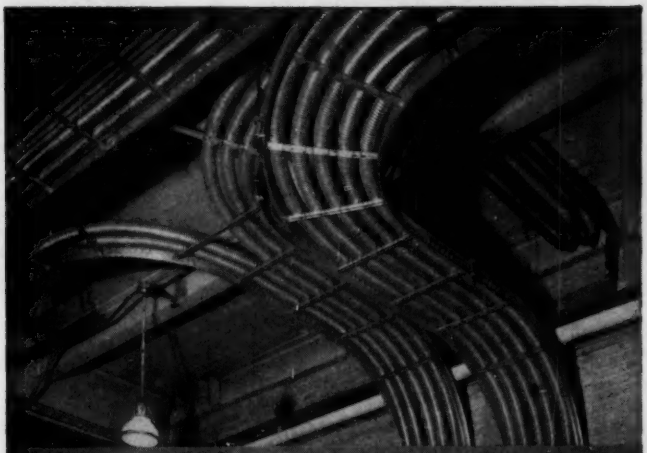
Here's the big difference in opposed compressor design—a Worthington exclusive that gives you permanent frame alignment . . . for longer wearing parts life, less maintenance.

Locked in place over each main bearing is a heavy steel tie bar. This makes the frame strongest at the point of greatest loading, assuring years of heavy duty, continuous operation. When necessary, the tie bars are easy to remove for inspection or maintenance.

Other advantages. The Worthington balanced opposed design is more compact, cutting the amount of foundation and floor space needed and saving installation time and expense. It's highly suited to large horsepower multi-service or multi-stage applications. Up to four cylinder pairs can be arranged on one frame.

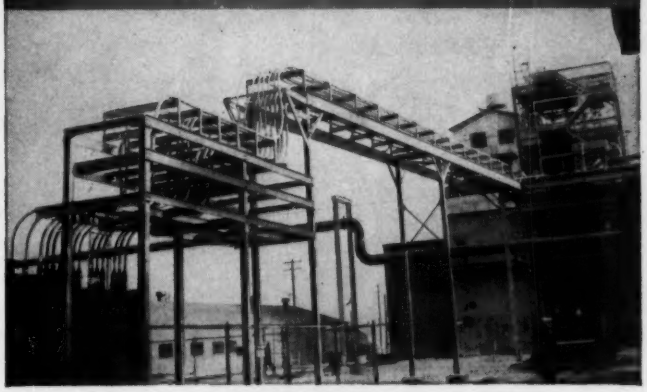
For more information, see your nearest Worthington District Office or write to Section K63, Worthington Corporation, Harrison, N. J. K-63

WORTHINGTON



INDOORS

OUTDOORS



rubber-insulated **LOXARMOR CABLES** save space, reduce cost

Considerable interest is growing throughout industry in Loxarmor (interlocked armor) Cables for use in locations where the maximum protection of a rigid conduit is not required. Okonite's interlocking Loxarmor covering makes the cable flexible and easy to train (minimum bending radius 8 times cable O.D.) and at the same time provides mechanical sturdiness. Installation costs are lower than for rigid conduit systems, and Loxarmor's accessibility makes it easier and cheaper to reroute or add circuits. Its compactness provides important space-saving features where runs must be installed around existing plant equipment. Loxarmor coverings can be supplied in galvanized steel, aluminum, bronze or copper.

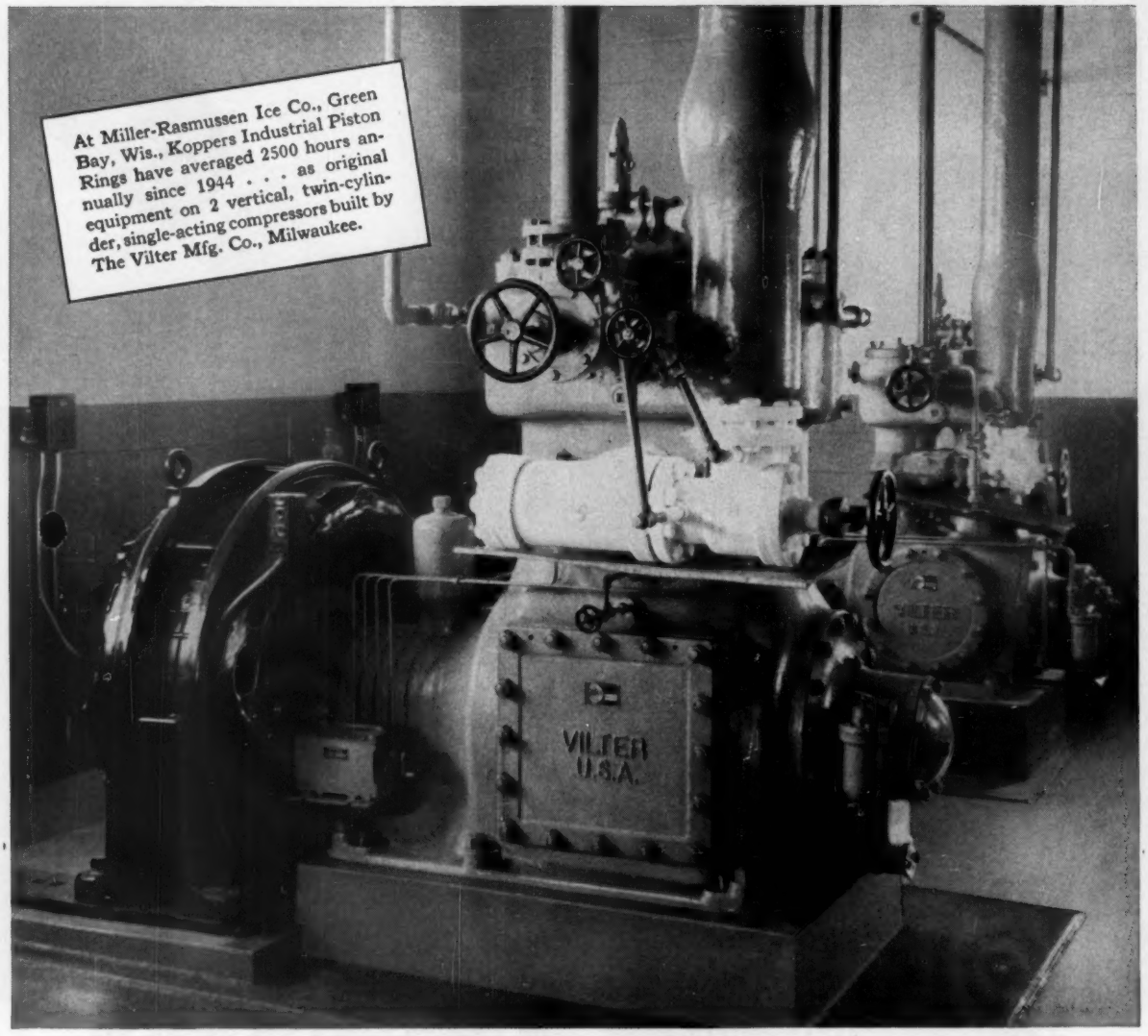
Okonite rubber-insulated Loxarmor Cables are insulated with Okonex, a butyl-base compound applied by Okonite's famous strip-insulating process. Vulcanized in a metal mold, the insulation forms a solid dielectric wall which has better moisture resistance and electrical properties than laminated varnished cambric insulations. The superiority of Okonex is indicated by its higher insulation resistance, lower dielectric loss, lower power factor and lower specific inductive capacity.

Okonex-insulated Loxarmor Cables are suitable for operation up to 15,000-volts and at conductor temperatures up to 85C. For complete information on Okonite Loxarmor Cables, including detailed splicing and terminating drawings and instructions, write for Bulletin PW-1090. The Okonite Company, Passaic, N. J.

Available with either copper or aluminum conductors

OKONITE SINCE 1878 ***insulated cables***

2174



At Miller-Rasmussen Ice Co., Green Bay, Wis., Koppers Industrial Piston Rings have averaged 2500 hours annually since 1944 . . . as original equipment on 2 vertical, twin-cylinder, single-acting compressors built by The Vilter Mfg. Co., Milwaukee.

Koppers Piston Rings go 10 years without repair, replacement or oil waste!

Like Miller-Rasmussen Ice Co., you can reduce maintenance costs and time and increase operating efficiency with Koppers Industrial Piston Rings. You can profit from longer piston ring life . . . longer cylinder life . . . and eliminate piston ring feather, scoring and scuffing.

Koppers American Hammered Industrial Piston Rings prolong the lives of Diesel, gas, aircraft, gasoline and many other engines, valves and compressors. Rings range in diameter from 1 inch to 10 feet . . . are of cast iron and special alloy cast irons; they may be chromium-plated for added durability.

Our field engineers in your area will be glad to unravel your knottiest piston ring problems and help provide you with a new high in piston ring performance. They'll check your present piston rings in operation . . . recommend the proper ring type . . . or even have a ring designed for your specific application.

Bring your piston ring problems to Koppers. Phone or write: KOPPERS COMPANY, INC., *Piston Ring and Seal Dept.*, 2107 Scott St., Balto. 3, Md.

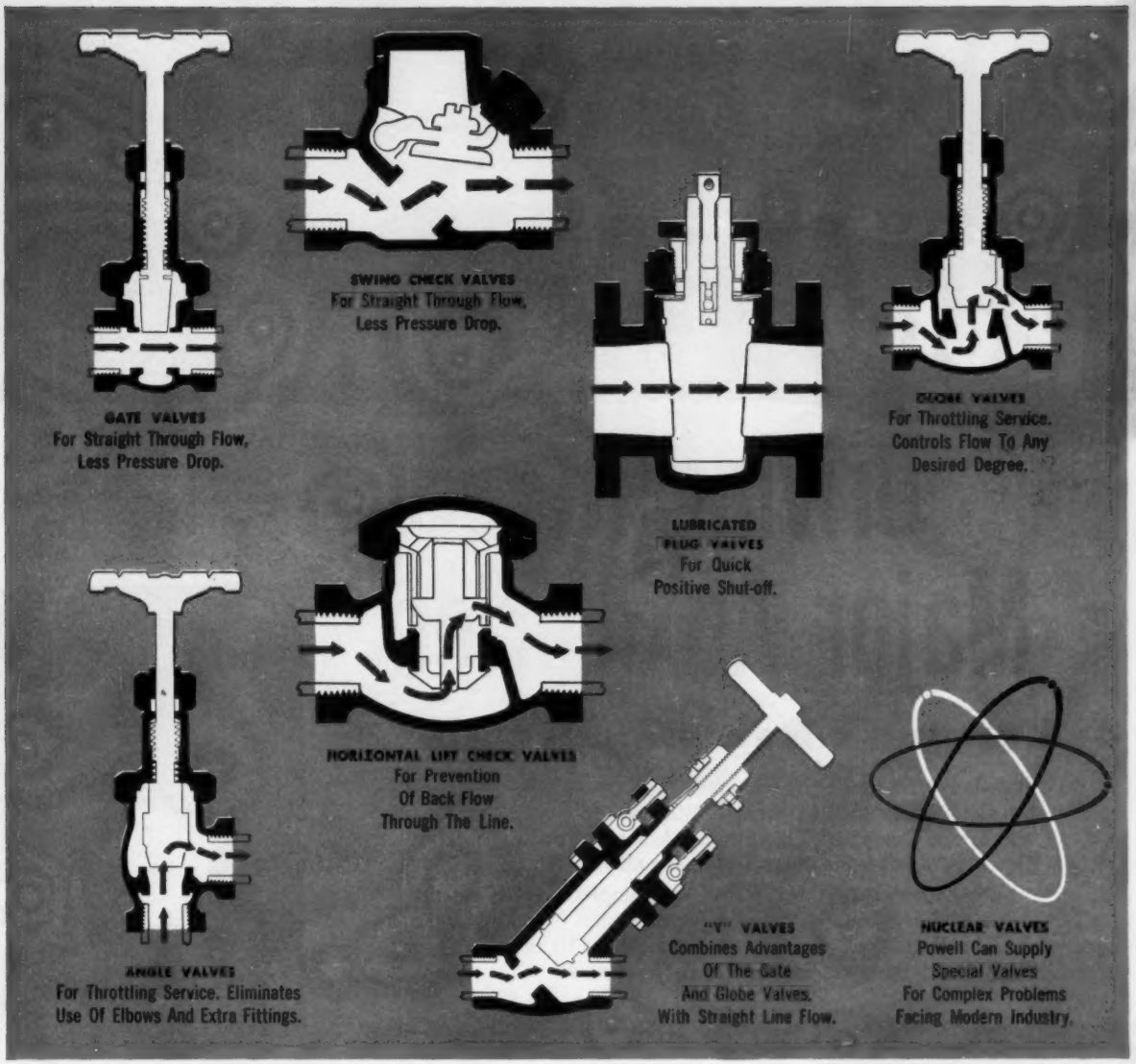
Koppers Company, Inc.
Metal Products Division
Piston Ring and Seal Dept.

***Engineered* Products**
Sold with *Service*

KOPPERS ®

AMERICAN HAMMERED
Industrial Piston Rings

POWELL
for all valve needs



for every flow control problem there is a right Valve

Powell can supply this right valve–*made right* of the right material*. Every part of every valve must pass rigid inspection. And as a final step in manufacture, every Powell Valve has *Performance Verified* through an *actual line test.*

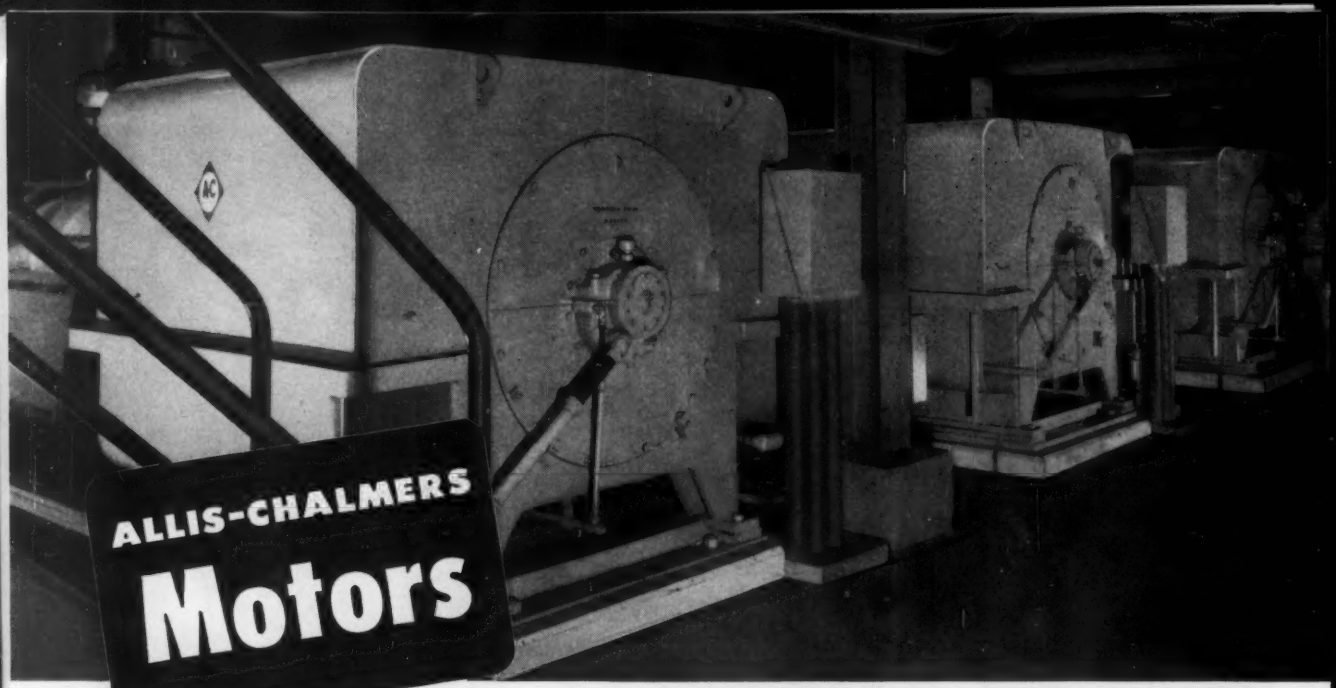
As an aid in selecting the right valve, the basic valve designs are illustrated here. For complete information on the wide range of sizes and materials available in each type of the basic valves illustrated above, consult your Powell Valve distributor. If none is located near you–or if you have a special flow control problem–write direct to The Wm. Powell Company, Cincinnati 22, Ohio.

PERFORMANCE
PV
VERIFIED

The Wm. Powell Company, Cincinnati 22, Ohio . . . 110th YEAR

POWELL VALVES

*BRONZE, IRON, STEEL AND CORROSION RESISTANT VALVES.



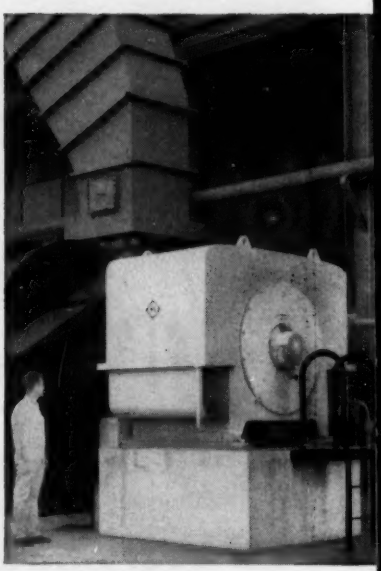
Driving ALL Major Auxiliaries

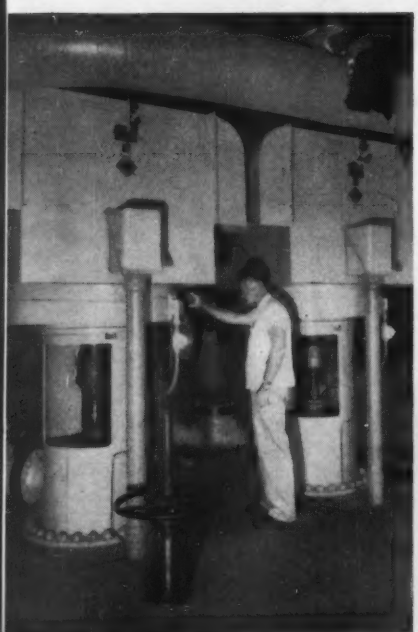
at Houston's New Webster Station

Weather-protected Allis-Chalmers motors are used throughout the modern outdoor Webster Station of Houston Lighting and Power Company. They provide low-cost outdoor installation plus dependable operation under all weather conditions.

These motors are but a few of the complete line of motors Allis-Chalmers builds for power plant service. Check with the A-C office in your district or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin. A-4832

Three of the six 1750-hp, 3575-rpm, 2300-volt Allis-Chalmers two-pole motors providing unusually quiet drives for boiler feed pumps.

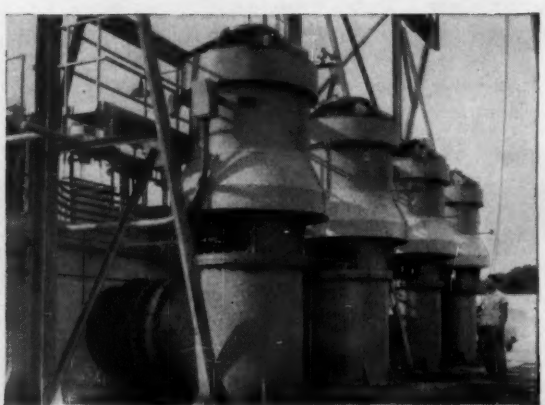




Two 350-hp, 1170-rpm, 440-volt Allis-Chalmers condensate pump motors.

One of four 1250-hp, 880-rpm, 2300-volt cage motors driving forced-draft fans.

ALLIS-CHALMERS



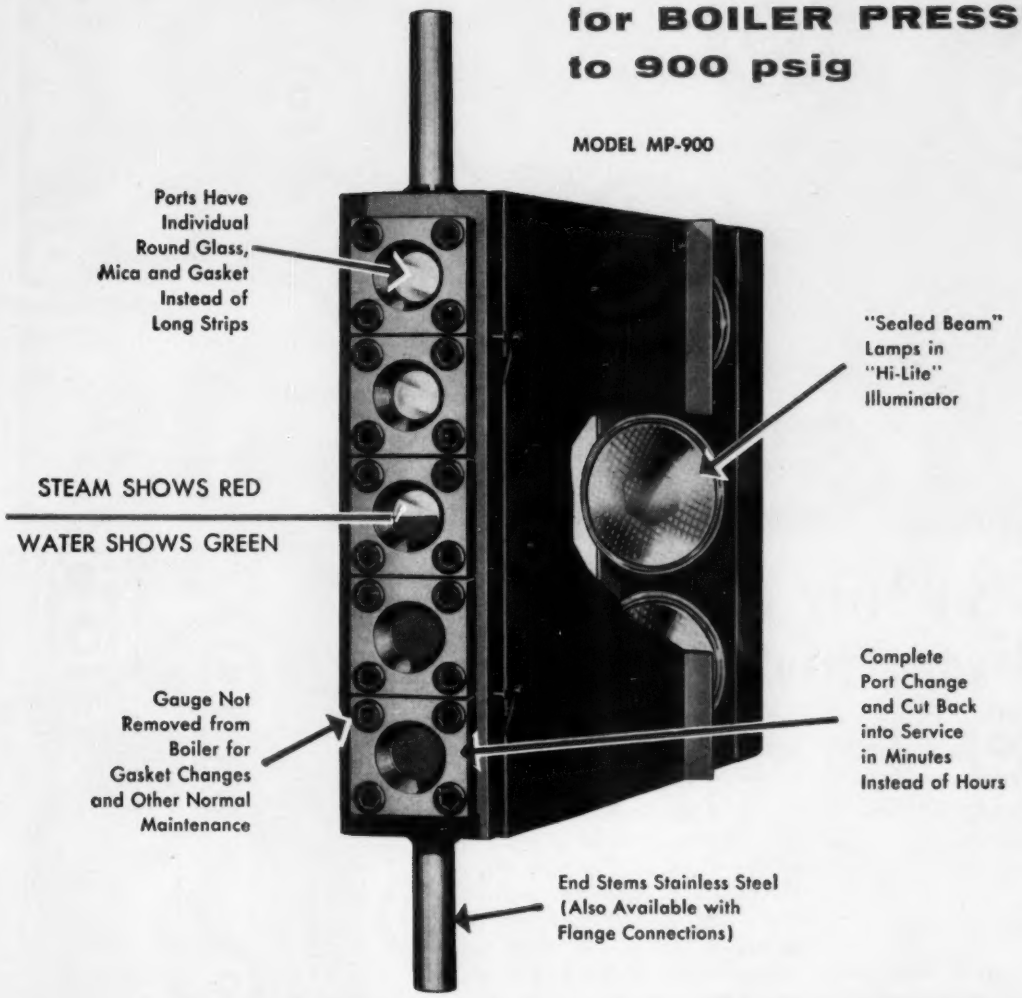
Four 800-hp, 514-rpm, 2300-volt vertical Allis-Chalmers circulating water pump motors.

Engineers and Constructors — Ebasco Services Incorporated

Announcing ...DIAMOND "Multi-Port" Bi-Color Gauge

for BOILER PRESSURES to 900 psig

MODEL MP-900


Ports Have Individual Round Glass, Mica and Gasket Instead of Long Strips
"Sealed Beam" Lamps in "Hi-Lite" Illuminator
STEAM SHOWS RED
WATER SHOWS GREEN
Gauge Not Removed from Boiler for Gasket Changes and Other Normal Maintenance
Complete Port Change and Cut Back into Service in Minutes Instead of Hours
End Stems Stainless Steel (Also Available with Flange Connections)

The individual round ports each having its own round glass, round mica and round gasket (instead of the conventional long strips) means less stress and strain . . . resulting in greatly reduced maintenance. When replacement is required, it is usually only one port . . . which can be changed in a very few minutes . . . and without removing the gauge from the boiler.

The Diamond Bi-Color feature is another important advantage of the MP-900 Multi-Port . . . steam always shows red and water always shows green. There can be no question of the water level.

Recommended for both new and old boilers up to 900 psig, the MP-900 Multi-Port will give you a new standard of gauge operation. Use the coupon below for additional information.

7358

DIAMOND POWER SPECIALTY CORP. U
LANCASTER, OHIO

Please send me without obligation a copy of new Bulletin No. 2044 explaining the advantages of the Diamond MP-900 "MULTI-PORT" Bi-Color Gauge for all boiler operating pressures up to 900 psig.

NAME_____

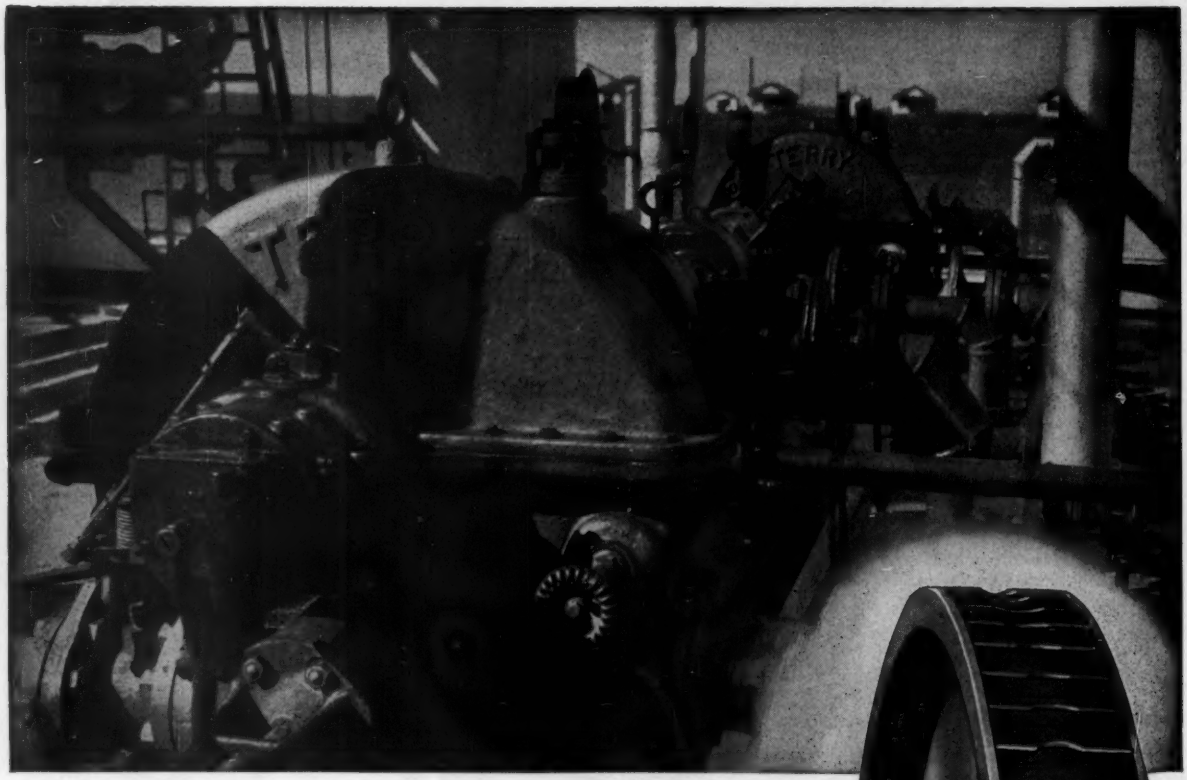
COMPANY_____

ADDRESS_____

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO

Diamond Specialty Limited • Windsor, Ontario



Two Terry Turbines equipped with "trouble eliminators"

Because these turbines have solid wheels, they can take a lot of abuse, without complaint. Here's why:

1. The wheel has no separate parts to become loose or work out. It is a single forging, in which a series of semi-circular buckets is milled.

2. Blade wear is of little consequence because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Wear does not materially affect horsepower or efficiency.

3. The blades cannot foul. There is a one inch clearance on either side of the wheel and, in addition, the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets in a direction at right angles to the shaft.

For complete details of these *work horses of industry*, send for a copy of bulletin S-116. No cost or obligation.

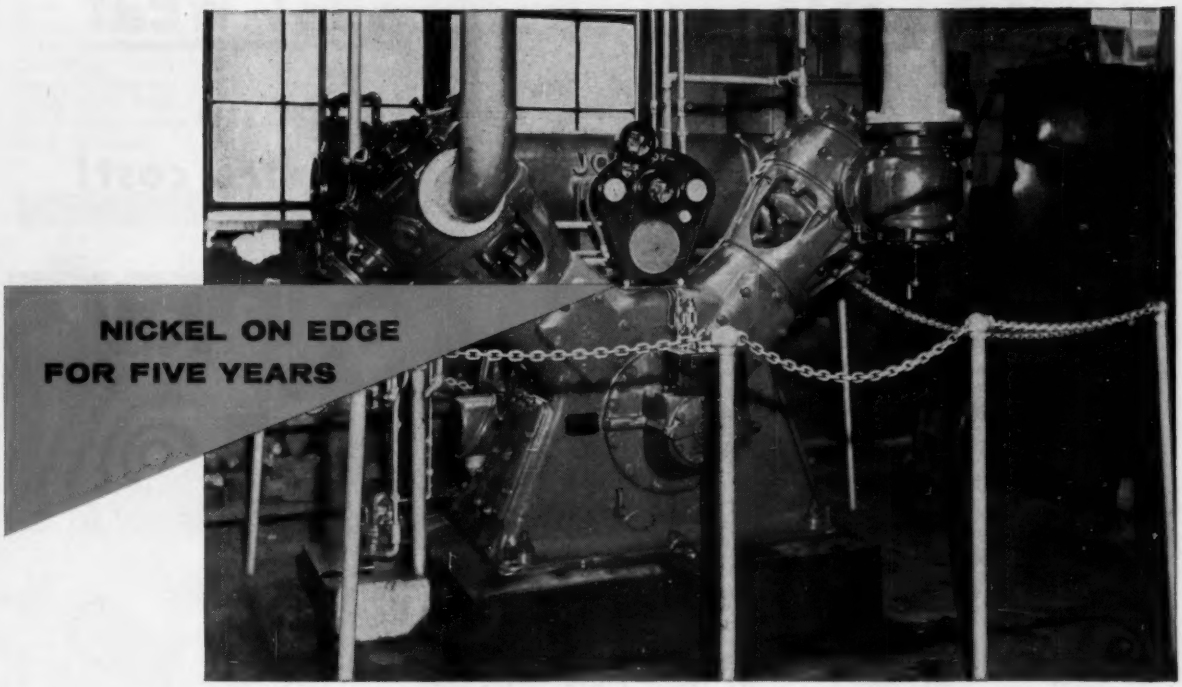
THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

TERRY

EA-1159

Proof... the JOY WN-112 COMPRESSOR is Vibration-free



VICE PRESIDENT GEORGE F. FRANCK, of American Tank & Fabricating Company, Cleveland, writes about his Joy Compressor:

"Although the WN-112 has been in constant use for five years, we have experienced no trouble. It is vibrationless in operation . . . we are delighted with its performance."

The Joy WN-112 is a heavy-duty, continuous service, double-acting, water-cooled compressor with capacity from 378 to 974 CFM, 125 psi. Its vibrationless performance is the result of balanced V-vertical cylinder design with flange-mounted motor.

Other features of the WN-112 that assure efficient, quiet operation and long service are the exclusive Joy "Dual Cushion" valves, the *replaceable* cylinder and crosshead liners, full force-feed lubrication (even to the crosshead face), and oversize non-adjustable spherical-type main bearings.

For complete details on Joy WN-112 Compressors, write **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

A nickel was balanced on edge on this compressor (American Tank & Fabricating Company) when it was started up five years ago. It is still standing there!

Write for FREE Bulletin 90-16

Consult a Joy Engineer

For Air and Gas Compressors, Oxygen and Nitrogen Generators, Vacuum Pumps and Boosters, Conveyors, Fans, Electrical Connectors, Hydraulic Fittings and Hose Assemblies.

WSW 16083-90

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

Hard faced to resist seat wear

WITH STELLITE

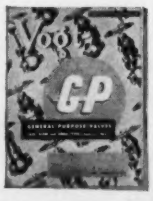
...at no extra cost!

GP Globe Valve-Series 800

Stubborn resistance to valve seat wear, due to erosion, corrosion and galling, is built into Vogt GP valves with Stellite faced seating surfaces used in conjunction with hardened discs and wedges. By an exclusive method, hard facing alloys are welded to the integral seat of globe and angle valve bodies and to the removable stainless steel seat rings of gate valves.

This important feature, available at no extra cost, assures operation economies and longer valve life. A catalog describing the complete General Purpose line of valves in sizes 1/4" to 2" will be sent on request.

Adv. No. 3 in a series describing the features of Vogt GP valves.



Write For Your FREE COPY of Supplement No. 1 to Catalog F-9. Address Dept. 24-FP

HENRY VOGT MACHINE CO.
P. O. Box 1918 • Louisville 1, Kentucky

SALES OFFICES:

New York, Philadelphia, Cleveland, Chicago, St. Louis, Charleston, W. Va., Cincinnati, Dallas, San Francisco

Vogt GENERAL PURPOSE GP Vogt FOR BETTER VALVES

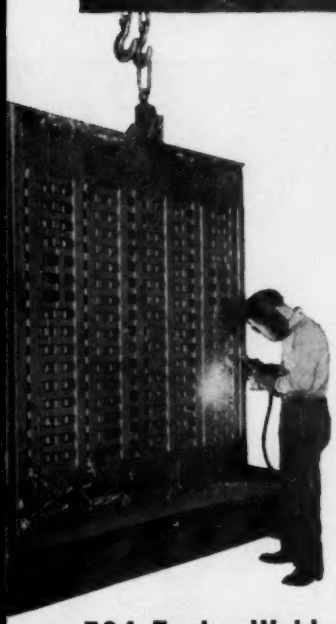
DROP FORGED STEEL

VALVES

HOW USS "T-1" STEEL IMPROVES THESE PRODUCTS...

. . . Lops Off 1,047 Lbs.

Trays for ore clean-up buckets need tremendous resistance to impact, abuse, and abrasion. Blaw-Knox Company, Pittsburgh, Pa., found that they weigh half a ton less, and cost less to fabricate when made from USS "T-1" Steel plate instead of heavy steel castings.



. . . 534 Easier Welds

This printing press bedplate manufactured by Graver Tank & Manufacturing Co., Inc., must be welded in 534 places. High alloy steel with the needed strength was very difficult to weld. But USS "T-1" Steel is easy to weld . . . and has the needed strength to keep these bedplates, used on high-speed printing presses, as lightweight as possible.

Three Ways Better . . .

International Nickel Company of Canada expects USS "T-1" Steel to increase the service life, to reduce the maintenance, and lower the long-term cost of ore cars like this one; because "T-1" Steel has far greater strength, toughness, and resistance to abrasion than steel used previously. The car builder, Canadian Car and Foundry Co., Ltd., has had no difficulty fabricating this very strong alloy steel.

HOW USS "T-1" STEEL CAN HELP YOU

The great strength and toughness of USS "T-1" Steel (90,000 psi, minimum yield strength) helps you to increase the capacity and durability of power-shovel buckets and storage tanks without increasing weight.

Its excellent weldability enables you to fabricate large equipment out in the field without heat treatment. It thus reduces fabricating and shipping costs and speeds up construction.

Its unusual toughness at sub-zero temperatures improves service life of equipment that must take impact, abrasion, and abuse in all weather.

USS "T-1" Steel also gives you good creep-rupture strength to 900°F. It often can be substituted for more expensive steels that are more difficult to fabricate. There is a place for "T-1" Steel somewhere in your designs. Write, wire, or phone for complete information. United States Steel, Room 5385, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.

UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T1" CONSTRUCTIONAL ALLOY STEEL

USS

See The United States Steel Hour. It's a full-hour TV program presented every other week by United States Steel. Consult your local newspaper for time and station.

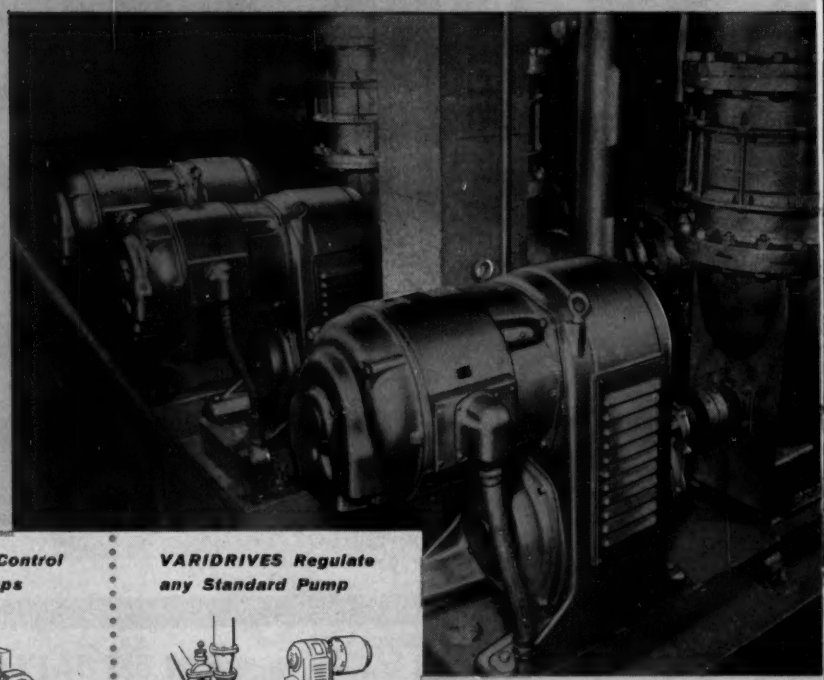
UNITED STATES STEEL

VARIABLE SPEEDS FOR VARYING NEEDS

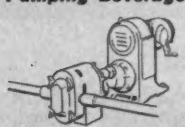
Control Pumping with U.S. VARIDRIVES

Regulating the High and Low of Sewage Flow with U.S. VARIDRIVES

Thirty-two 20 h.p. U. S. Varidrive motors like these shown increase or decrease necessary pumping action of axial flow pumps which transfer sewage at the new Hyperion Sewage Disposal Plant of the City of Los Angeles. This is another example of the versatility of U.S. Varidrive motors to handle variable speed pumping problems in all types of industry. Varidrives are available from ¼ to 60 h.p. Speeds 2 to 10,000 rpm.

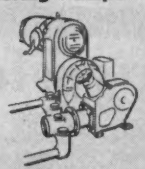


VARIDRIVES Power Pumps used for Pumping Beverages



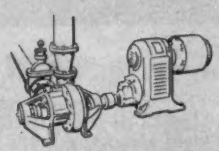
High pressure, low volume rotary positive displacement pumps used in food plants have a variety of uses with the help of variable speed.

VARIDRIVES Control Metering Pumps



Piston type, positive displacement pumps used for proportioning or metering liquids are often regulated by Varidrives.

VARIDRIVES Regulate any Standard Pump



Centrifugal pumps are made more versatile in handling many different pumping conditions with variable-speed drives.

Versatile VARIDRIVE for Additional Applications

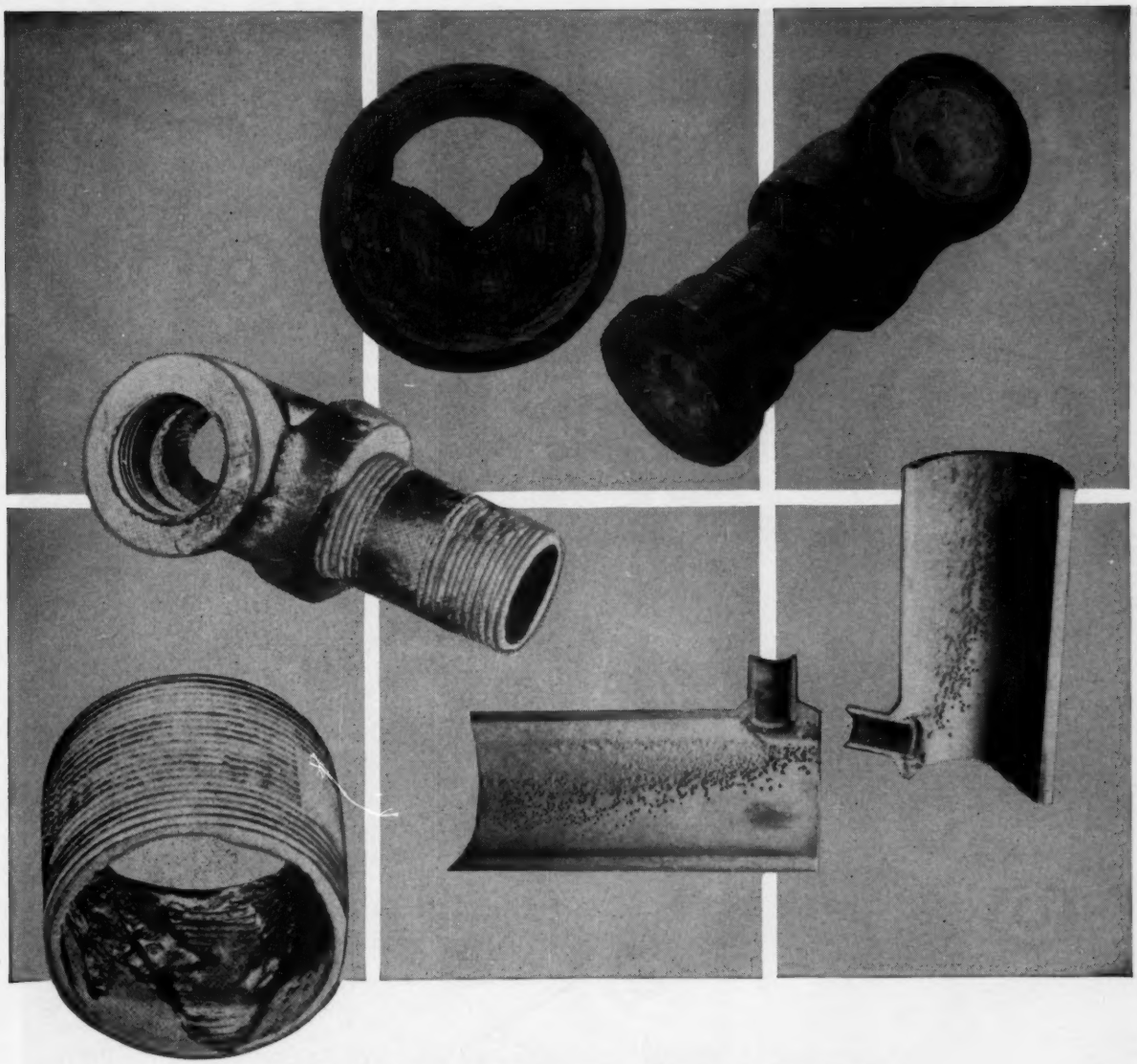
- CONVEYORS
- PUNCH PRESSES
- LATHES
- EXTRUDERS
- PACKAGING
- SPOOLING
- MIXING & BLENDING
- CANNING
- GRINDING
- VENTILATION
- BUFFING

U.S. Electrical MOTORS

U.S. Electrical Motors Inc. PO-7
P.O. Box 2058, Los Angeles 54, Calif. or Milford, Conn.
☐ Send U. S. Varidrive Bulletin #1797

NAME_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____

MAIL COUPON NOW



WHAT'S YOUR TROUBLE?

Each of these destroyed parts had to be taken out of service because of incomplete or inadequate water treatment. Replacement meant loss of steam production . . . new equipment expense . . . added labor-repair costs.

DEARBORN COMPLETE WATER TREATMENT SERVICE eliminates this by providing trouble-free water—a vital necessity to every user of industrial steam. Dearborn's many years of leadership in the field of water treatment will help keep your power plant operating economically.

CALL ON YOUR DEARBORN SALES ENGINEER for (1) analysis of raw water (2) recommendation of test procedures (3) proper treatment (4) a manually or automatically controlled feeding system.

Dearborn®

combatting corrosion wherever it occurs

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PO
Chicago 54, Ill.

Please send me
- ☐ Internal Treatment Bulletin 5000
- ☐ Filmeen Bulletin 5013-A
- ☐ Dearborn "659" Bulletin 5008
- ☐ Have a Dearborn Sales Engineer call.

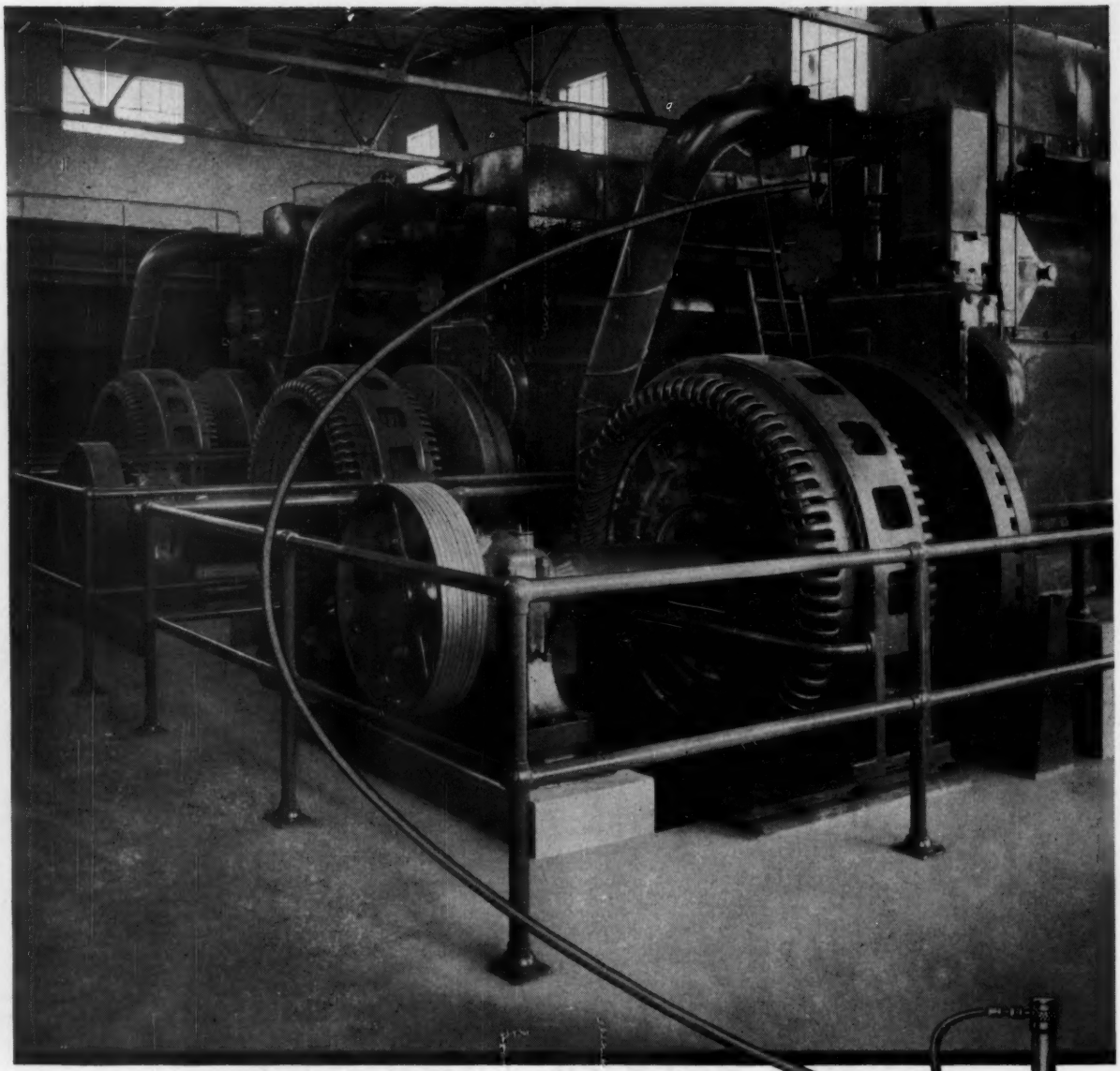
Name.....

Company.....

Position.....

Address.....

City..... *Zone*..... *State*.....



NO STUCK RINGS!

Stop the formation of varnish, sludge and carbon in your Diesels and *keep it stopped* with Sinclair RUBILENE®, the high viscosity index oils proved by over 35 years in industrial Diesel applications. RUBILENE earns its reputation by its performance under continuous operation and heavier loads. It fights deposits and gives better protection to cylinders, pistons, rings and other vital moving parts. Your Diesel stays on the job longer . . . service time is cut 'way 'way down!

Let RUBILENE help solve your lubrication problems. Regardless of the make or age of your Diesel, where a high VI oil is needed, there's a member of Sinclair's RUBILENE or RUBILENE HD family that meets your requirements exactly. Call your local Sinclair Representative for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Ave., New York 20, N. Y. *There's no obligation.*

SINCLAIR RUBILENE OILS

Nicholson *steam trap* quality *gives you* . . .

extra stamina for severest service

Write, today, for your copy of new Bulletin 10-55—for detailed information.

Nicholson quality . . . throughout . . . means the extra strength, extra capacity, extra stamina that never let down. And, Nicholson quality pays off, when it comes to discharging condensate and air from steam distribution lines and equipment . . . most efficiently, dependably, economically.

- **powerful valve action—big husky bellows.**
- **positive shut-off—finely ground valve and seat.**
- **high capacity—effective use of large orifice.**
- **each unit service tested—with steam.**

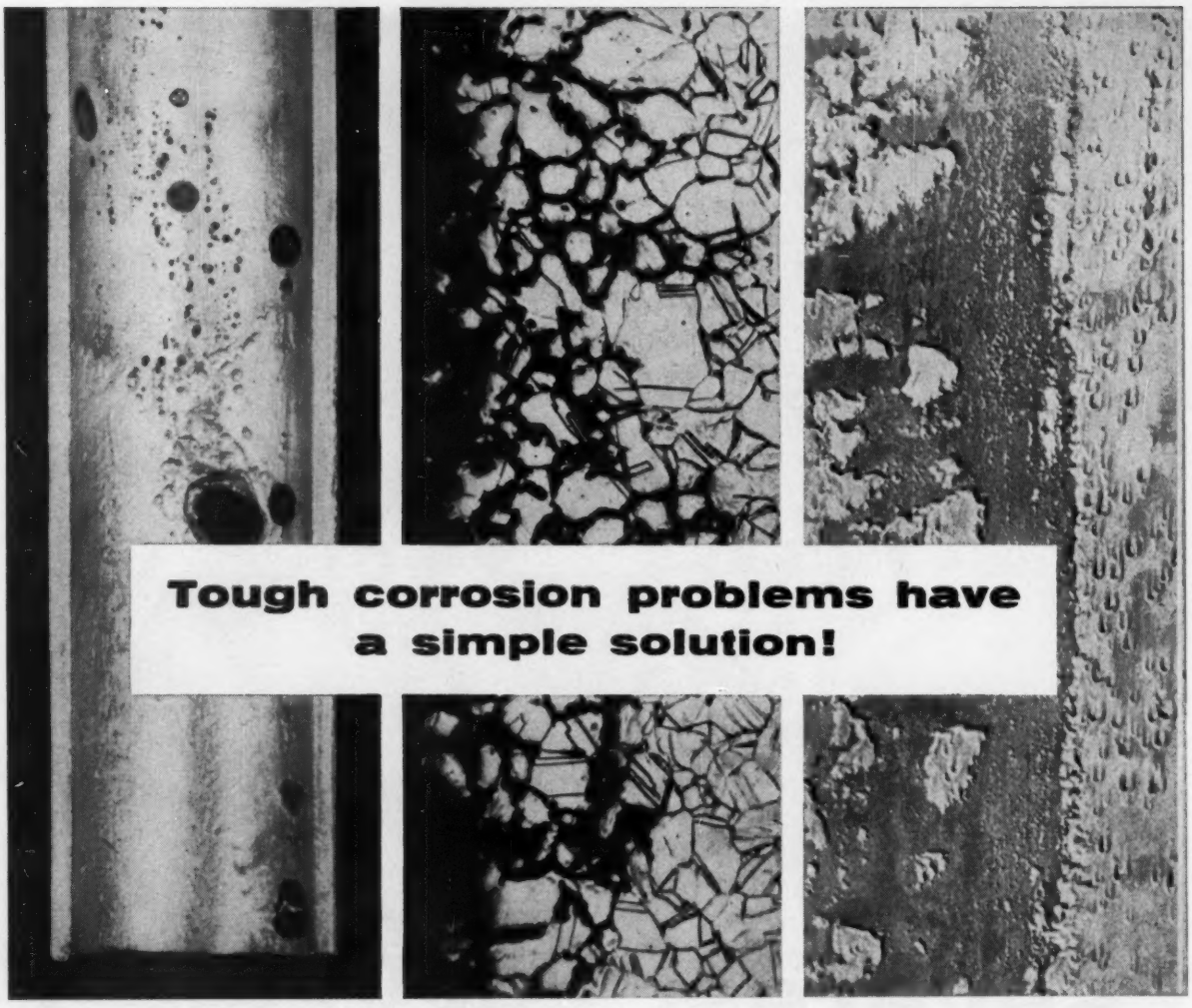
When less than the best won't do, specify Nicholson.

NICHOLSON

W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS
LAUNDRY, DRY CLEANING AND PRESSING MACHINERY

14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 98 PRINCIPAL CITIES



Tough corrosion problems have a simple solution!

Dezincification

Since 1935, when it was first introduced by Chase, there has *never* been a reported dezincification failure of Chase Antimonial Admiralty tube—and over one-hundred and twenty million pounds have been installed in heat exchangers and condensers!

Intercrystalline Corrosion

Both Chase Antimonial and Chase Cupro-Nickel are highly resistant to intercrystalline corrosion. Alloying elements are properly distributed, grain size carefully controlled, internal stresses minimized—throughout every length of tube!

Impingement

Even turbulent, high-velocity salt water flow is stymied from destructive cavitation in Chase Cupro-Nickel tube. This alloy forms a tough protective oxide film on its surface that strongly resists those horseshoe-shaped impingement pits!

Get full details on *all* Chase heat exchanger and condenser tube alloys.
Write for Free 54-page manual: CHASE Condenser and Heat Exchanger Tubes!

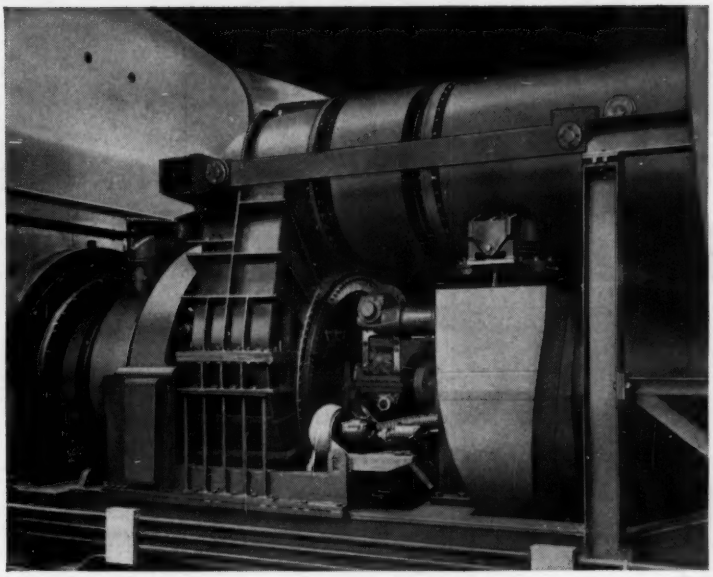
Chase

BRASS & COPPER CO.

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass, Copper and Stainless Steel

Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury



Clark 8500 BHP Gas Turbine for centrifugal compressor, generator or pump drive.

GAS TURBINES + CENTRIFUGAL COMPRESSORS

Only CLARK builds both!

Now you can get centrifugal compressors and modern gas turbines to drive them *exclusively* from one manufacturer . . . Clark.

In addition to saving money and headaches, you'll get proved, matched-performance "packages" specifically designed for continuous trouble free service.

Whether you have a million or a billion cubic feet of air or gas per day to handle at pressures of up to 4500 pounds per square inch, there is a Clark centrifugal compressor and in most cases a matching Clark gas turbine to drive it.

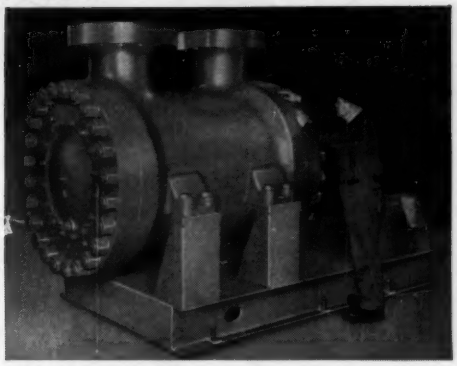
Your nearest Clark representative will be pleased to give you all the facts.

CLARK BROS. CO., OLEAN, N. Y.

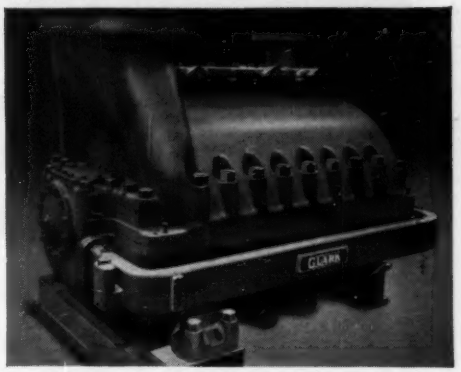
One of the Dresser Industries

Offices in Principal Cities throughout the World

Clark Barrel Type Centrifugal Compressors for extremely high pressures.



Clark Multi-Stage Centrifugal Compressors designed for process applications.



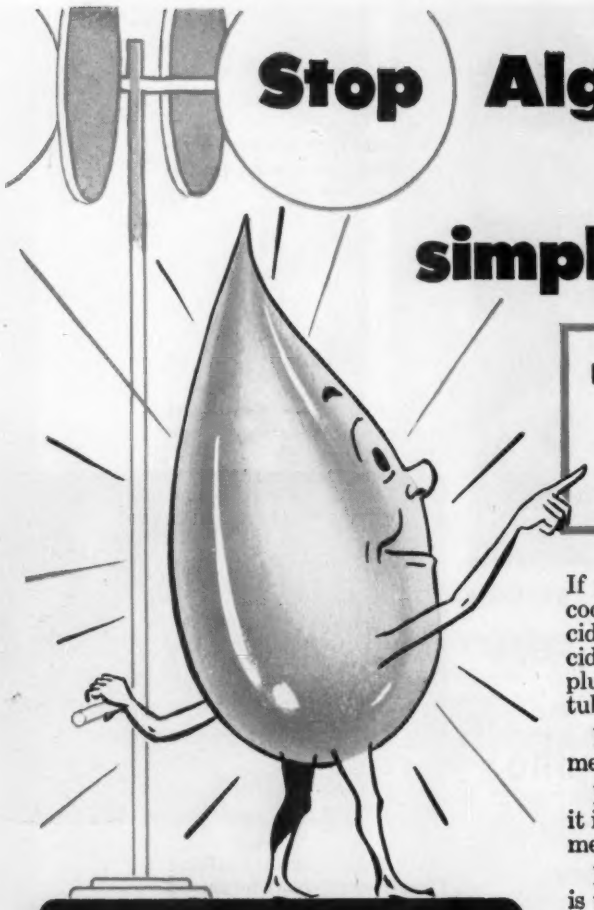
Clark Centrifugal Pipeline Booster for low ratios and high pressures.

CLARK®

ONE OF THE DRESSER INDUSTRIES

GAS TURBINES
CENTRIFUGAL COMPRESSORS

Stop Algae Problems NEW simple, low-cost way



NEW Allis-Chalmers Algaecide kills all classes of algae and other microscopic organisms in cooling water

If you are troubled by slimes and algae in your cooling tower system, new No. 120 Series Algaecide is the answer. It is the most effective algaecide known. It eliminates such problems as plugged pump strainers, coated heat exchanger tubes, coated slats in cooling towers.

It is easy to introduce into the system by means of a pump, drip feed or manual feed.

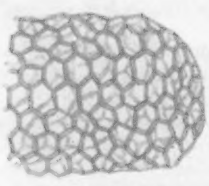
It is safe to handle. Even in concentrated form it is only a mild irritant to skin, eyes and mucous membranes.

Field tests prove that a 5-ppm concentration is toxic to most organisms.

Get complete information on No. 120 Series Algaecide. Call your nearest A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 28X8434.

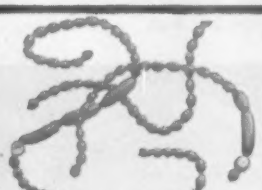
Call on
ALLIS-CHALMERS
for
Water Conditioning

As little as 2 ppm has killed all these algae



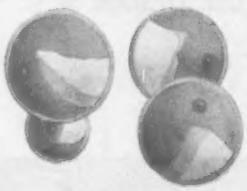
Hydrodictyon

Microcystis

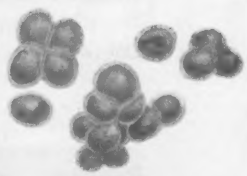


Anabaena

Oocystis



Chlorella



Protococcus

ALLIS-CHALMERS

A-5071

LOUIS N ROWLEY, EDITOR • JULY 1956 • ESTABLISHED 1882 **Power**

Ahead: a power-hungry 21st century

FORECASTS are always interesting. And when they're made by distinguished scientists they have special significance. That, we believe, is particularly true of the study made public recently by natural-resources experts of the California Institute of Technology.

Fifty years from now, they say, world population will have doubled. And the resources needed to support this vast population will be won only at the cost of vastly greater energy expenditures. More energy will be needed to find and process each gallon of fresh water. Farming will be ever more dependent on synthetic fertilizers, in which energy is a prime ingredient. Basic metals will be smelted from lower-grade ores—and eventually from common rock, if enough energy is applied. With an abundance of energy, the sea and the air will be increasingly important sources of a variety of raw materials.

In the 21st century, energy will be more than ever the key to the needs of mankind. And for these vast expenditures we must inevitably turn to resources as yet virtually untapped—the energy of the sun, and of the fissioning nucleus. And, almost surely, we will win controlled energy from the fusion process now exemplified in the awesome destructive force of the hydrogen bomb.

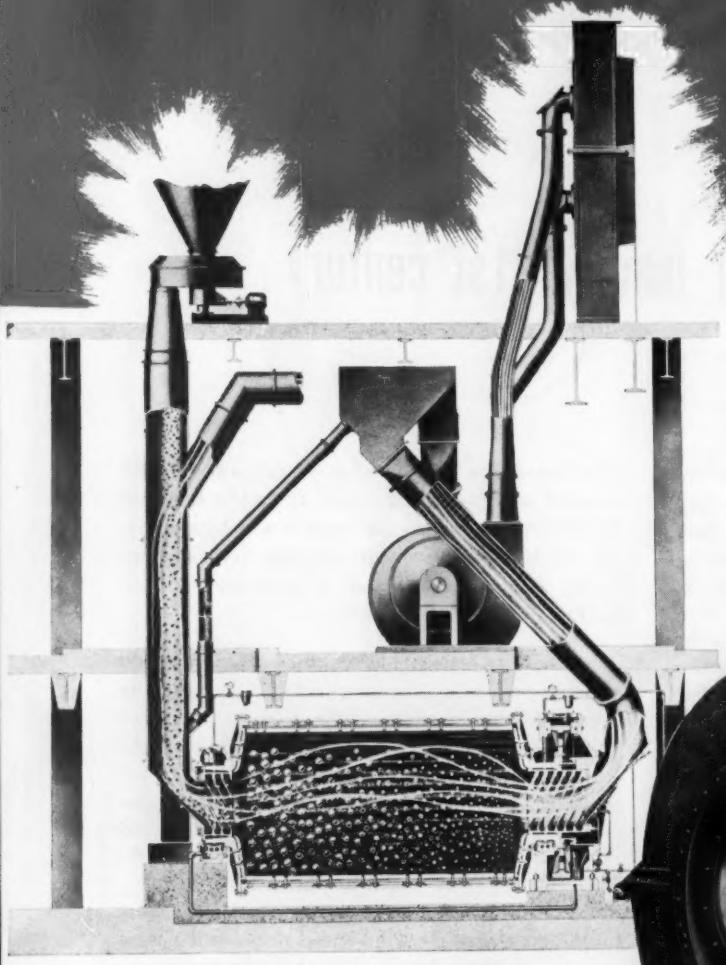
In this long perspective, the strides being made toward a U.S. nuclear-energy industry assume their true importance. Engineering editors saw one such forward step just a few weeks ago when they visited Babcock & Wilcox Company's new Lynchburg, Va. nuclear establishment—a plant for manufacturing fuel elements, and a critical-experiment facility.

In the fuel-element plant, fissionable uranium and fertile thorium, with zirconium for alloying and cladding, go through the complex series of metal-working operations needed to produce the precisely dimensioned assemblies that "fuel" a nuclear reactor. Even familiar operations pose new problems in a plant like this, handling materials of high strategic value and potency.

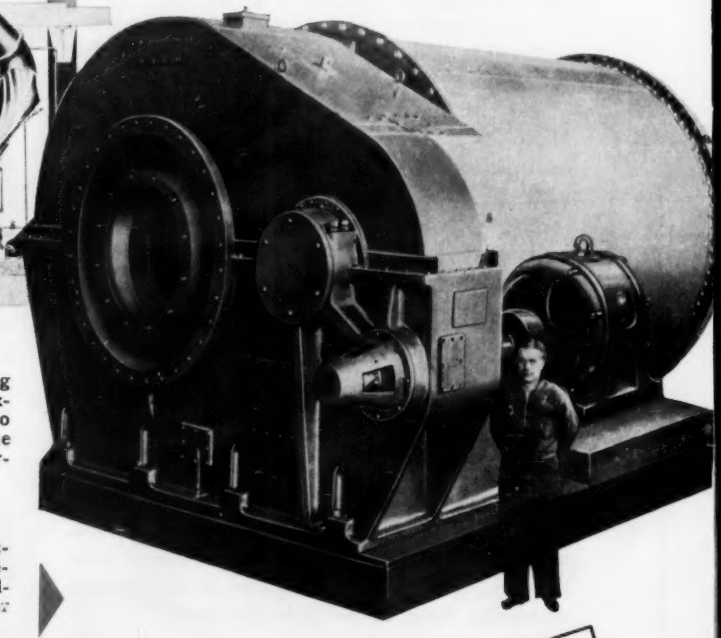
The critical-experiment facility does for the reactor designer what the wind-tunnel does for the aerodynamicist. Scaled-down fuel elements are assembled to form a reactor core that will operate at extremely low power levels. From its performance, designers can check the accuracy of their theoretical analyses.

Fuel-element plants and critical facilities are not new in themselves. But these units at Lynchburg are significant for one big reason. Both were built entirely with private funds. In developments like this we see the birth of a true nuclear-energy industry, the first big steps toward tapping a resource that will be of untold importance as we move into the energy-hungry years ahead.

USERS OF THE
PULVERIZED COAL



Unburnt Carbon Losses — LESS THAN ½%!



COAL FIRING SYSTEM
Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster and burners. Raw coal and pre-heated air up to 750° F enter one end of the pulverizer and leave at the other end. Moisture in the coal is liberated during pulverization.

INTEGRAL GEAR DRIVEN MILL
Slow-speed ball mill manufactured in large sizes producing 100 tons of pulverized coal per hour. Sturdy and reliable. Availability throughout the years over 99%. Grinding balls can be added without shutting down. Low power consumption.

KENNEDY-VAN SAUN
MANUFACTURING & ENGINEERING CORPORATION
TWO PARK AVENUE, NEW YORK
FACTORY DANVILLE, PA.

IT COSTS LESS... TO OWN THE BEST!

KENNEDY FIRING SYSTEM...

ARE SAVING UP TO $3.00 PER TON ON COAL COSTS...

MAXIMUM HEAT FROM PULVERIZED COAL . . .

Tremendous savings, often exceeding $3.00 per ton, are being realized by *burning any grade coal,* including the *cheapest available.* Because of the extremely fine pulverization with the KVS Coal Firing System, the cheapest grades of coal provide complete combustion comparable to that obtained from more costly fuel. Tramp iron not only cannot damage the mill, but actually helps pulverization!

The KVS Coal Firing System obtains maximum heat value from every ton of coal burned. More heat means more power available from any given quantity of coal. No other system produces comparable results. By pulverizing coal to a fineness of 85% to 90% through a U.S. standard 20 mesh screen, maximum results are obtained.

With the KVS system, coal firing is instantaneous, combustion complete. Unburnt carbon losses held to less than ½% at all ratings. Pulverized fuel instantly available to meet fluctuating loads with quick response to combustion controls. Free moisture is liberated in the mill while the coal is being pulverized.

To compare your present fuel costs with the results you can expect from a KVS Pulverized Coal Firing System, estimate your unburnt carbon losses . . . figure boiler efficiency at reduced rating . . . allow for coal loss when you change rating . . . include maintenance cost on equipment.

FEATURES OF THE KVS COAL FIRING SYSTEM

- FULLY AIR SWEPT
- COAL PULVERIZED TO SUPERFINENESS
- COAL COMPLETELY CARBURETED FOR RAPID COMBUSTION
- BIG TRUNNIONS FOR AIR SWEEPING
- 20% MOISTURE REMOVED WHILE PULVERIZING
- GRINDING BALLS ADDED WITHOUT SHUTTING DOWN
- LOW OPERATING AND MAINTENANCE COSTS
- UNBURNT CARBON LOSSES LESS THAN ½%
- INSTANT RESPONSE TO CONTROLS
- 85% TO 90% THROUGH 200 MESH
- PULVERIZES ANY COAL BITUMINOUS, ANTHRACITE, FLUID COKE, COKE BREEZE
- TRAMP IRON ACTUALLY AIDS IN PULVERIZING
- FUEL RESERVE FOR INSTANT RESPONSE TO DEMAND

GET THE FACTS ON THE KVS COAL FIRING SYSTEM!

WRITE TODAY FOR FREE BULLETIN DESCRIBING THIS EQUIPMENT!

NEW JONES & LAUGHLIN WATER-TREATMENT PLANT *with* AUTOMATION *and* EQUIPMENT *by* INFILCO

cuts hardness from 268 to 2 p.p.m. –greatly reduces labor costs

The Monongahela River is the source of raw water for steam generating plants of Jones & Laughlin Steel Corporation. Total hardness ranges up to 268 p.p.m.—clarity and degree of acidity fluctuate widely.

Using a cold-process, lime-batch plant, hardness could only be reduced to about 1.5 grains per gallon, or 26 parts per million.

INFILCO equipment, including C.-A.-P. SYSTEM® instruments was chosen for greater efficiency and automatic operation. The new plant produces water averaging about 0.1 grain per gallon —2 p.p.m.—hardness. It has cut labor costs more than 50% and made better service possible. And the end result — steam production — is more efficient and economical, too.

This is another example of INFILCO leadership in this field — further proof that

Infilco knows how

to help you solve your water-treatment problems. For complete information about this interesting installation, write today for Re print No. 70-PO-11.

INFILCO INC.

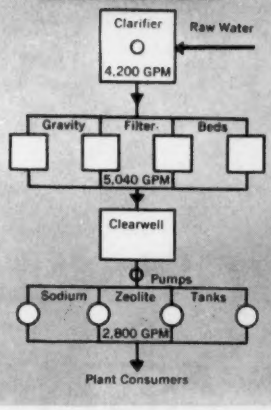
General offices, Tucson, Arizona

*The **one** company offering equipment for **all** types of water and waste treatment*

5611

FIELD OFFICES THROUGHOUT THE UNITED STATES AND FOREIGN COUNTRIES

INFILCO EQUIPMENT automatically

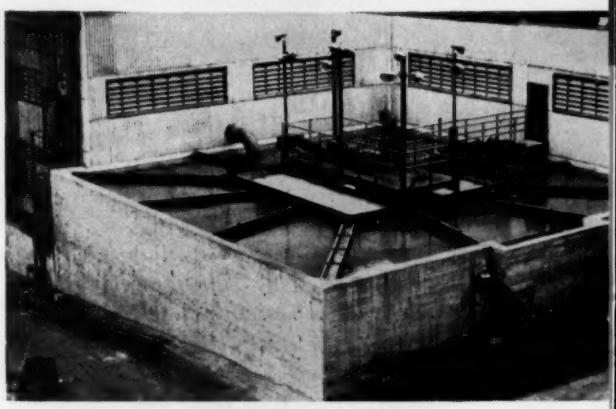


...MEASURES flow, maintains constant water level, keeps amounts of chemical proportional, removes sludge.

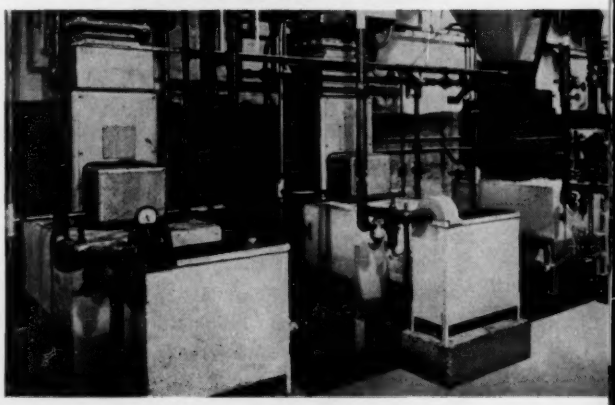
...EQUALIZES water passage by flow control and loss-of-head control, maintains same flow rate, controls backwash.

...PUMPS water to softening units and then meters it to five 175,000-lb./hr. boilers for steam generation.

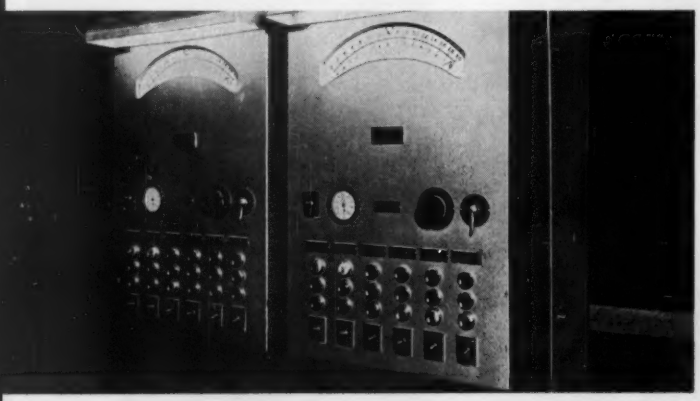
MAIN PLANT COMPONENTS AND AUTOMATION



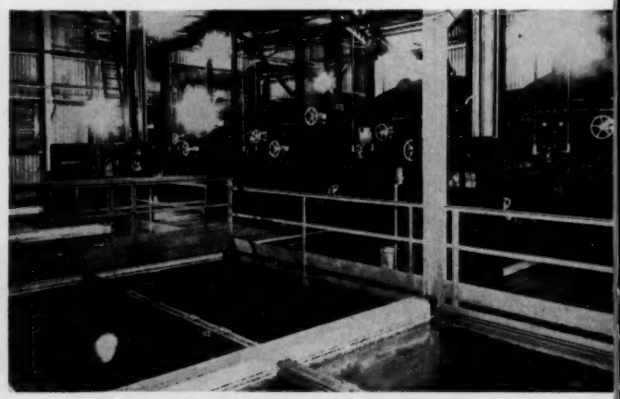
CLARIFICATION BASIN



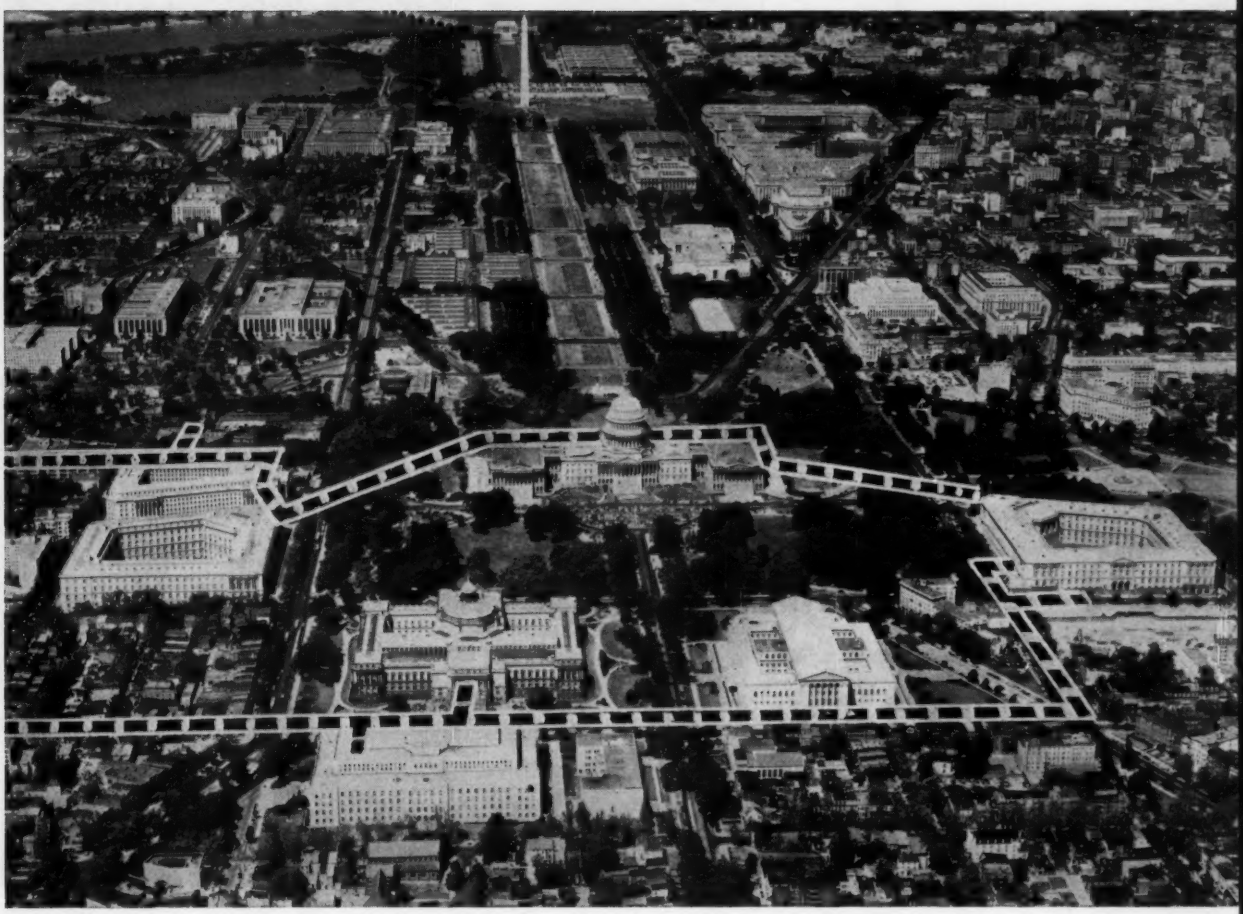
CHEMICAL FEEDERS

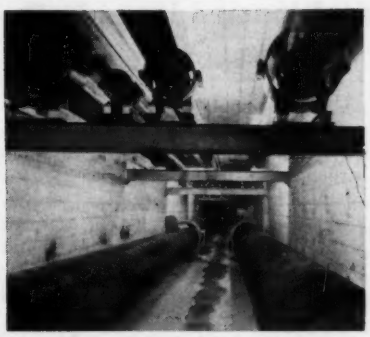


FILTER BED CONTROL PANELS



ELECTRICALLY CONTROLLED SODIUM-ZEOLITE SOFTENING UNITS





2-MILE TUNNEL, from Capitol Hill's central power plant, feeds heating steam and chilled water, to the major Congressional buildings, the U.S. Capitol, old and new House offices, Senate offices, Supreme Court, Library of Congress

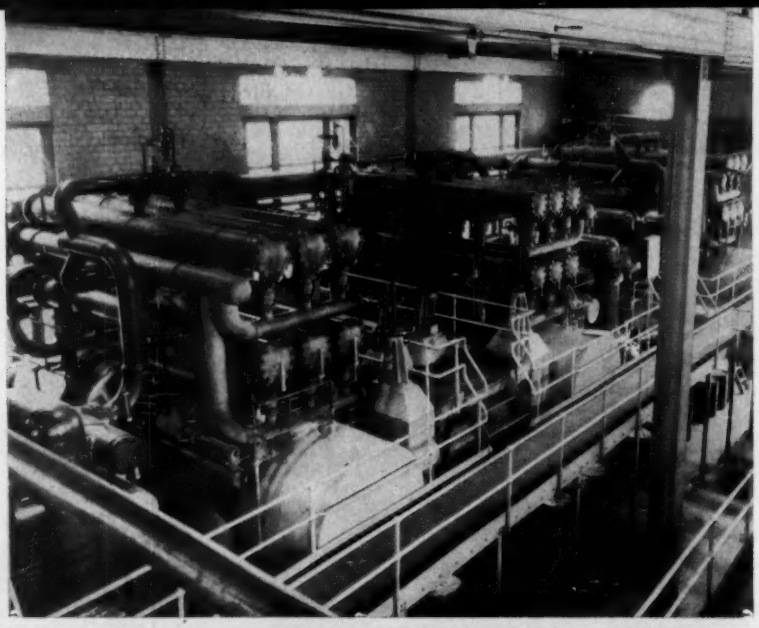
Cooling Capitol Hill

By J W CHANDLER, *Sales Engineer, York Corporation*

► BIGGEST in just about every respect and up-to-the-minute in engineering design. That's what Capitol Architect J George Stewart and Consulting Engineer Guy Panero were shooting for when they planned the Capitol's latest air-conditioning modernization. They were right on target—as you'll see from the engineering highlights we'll talk about in the following paragraphs.

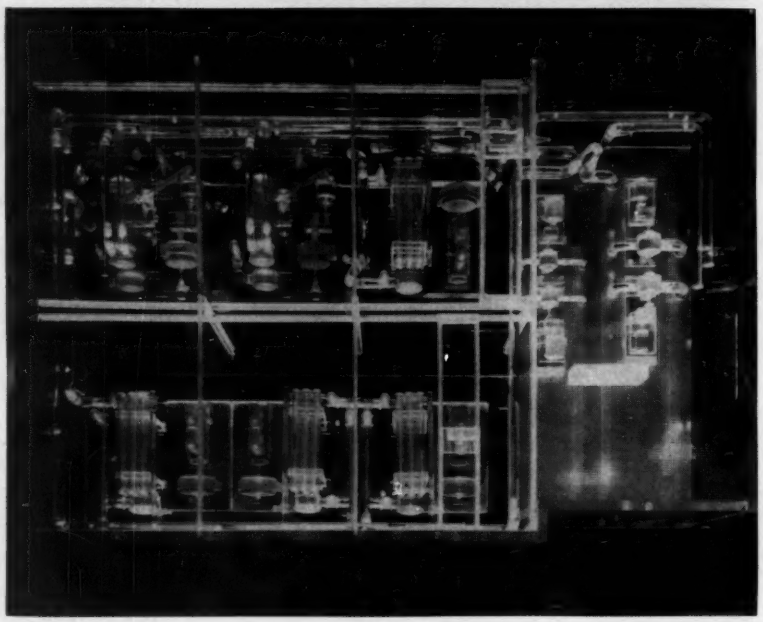
First built in 1937, by direction of the 74th Congress, the original refrigeration plant included six 800-ton reciprocating compressors. The machines were large and bulky by today's standards. They featured 22x18-in. 4-cylinder compressors with nests of condensers instead of a single condenser.

This 1956 cooling season signals completion of the first step of a 2-step



OLD ——→

Six reciprocating units, each rated at 800 tons, were heart of the Capitol's old system. Chilled water flowed through six chillers in series



NEW ——→

Four centrifugals, 2200 tons each, will replace the system in top photo. Model, *right*, shows two centrifugals in position, *upper left*, alongside four old units. Two more new machines will be installed this fall, completing the program

Swinging over from 25- to 60-cycle current loomed large in the

program to double the old air-conditioning system's size. It's designed to serve the Capitol, old and new office buildings of the House, Senate office building, the Supreme Court, the Library of Congress and its annex and the additional Senate Office building.

WHAT'S BEHIND PROGRAM

Heart of program's first step is two 2500-hp centrifugal compressors, each of which provides refrigeration for the biggest watercooling systems yet built. They're in action alongside four of the six old reciprocating machines that have been cooling the Capitol almost 20 years. To make way for the new centrifugals, two of the old compressors were removed. By late spring of 1957, the four remaining units will be replaced by two more centrifugals, bringing the modernized plant up to 8800 tons. New machines will take only two-thirds of the available space.

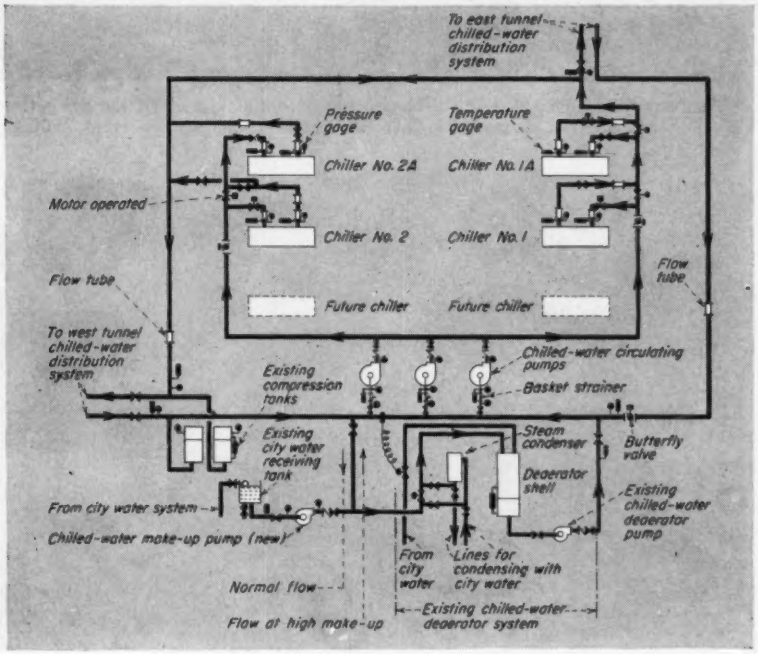
The Capitol Power Plant supplies steam and chilled water to Capitol Hill via a 2-mile walk-through tunnel, lower photo, p 75. The underground network carries pipe feeders from the power plant direct to using buildings. Air washers, chilled-water coils in each building condition air.

When Congress first decided to install air conditioning in the late 30s, main problem was lack of detailed structural plans of the older sections of the Capitol and House Office buildings. Engineers had to cut through walls, floors, relocate existing equipment, replaster.

Another major change at that time was replacement of a 36-in. cast-iron river-water circulating line that ran from the Capitol Power Plant to the pump house at the Anacostia River. In 1937, Capitol air-conditioning planners decided to (1) modernize the pumping station—originally installed

Air conditioning is part of a broad program to modernize Capitol Hill's power services

- **Construction of a new enlarged walk-through tunnel for service distribution**
- **Installation of three new 110,000-lb-per-hr steam generators**
- **Conversion from 25-cycle to 60-cycle current**
- **Modernization of the central chilled-water plant**
- **Installation of cooling-tower system for condenser water**



CHILLED-WATER FLOW in the central power plant. Two parallel systems each have two chillers in series. Engineers still have room for two more machines.

decision to replace the 20-year-old reciprocating machines

to supply condenser water to the steam plant (2) feed condenser water through refrigeration condensers, then to steam condensers.

Reason for modernizing. The new Senate Office building adds about 2000 tons to the load. And buildings already air conditioned are handling bigger loads. Also, some buildings are scrapping their own watercooling equipment, throwing more load on the central plant.

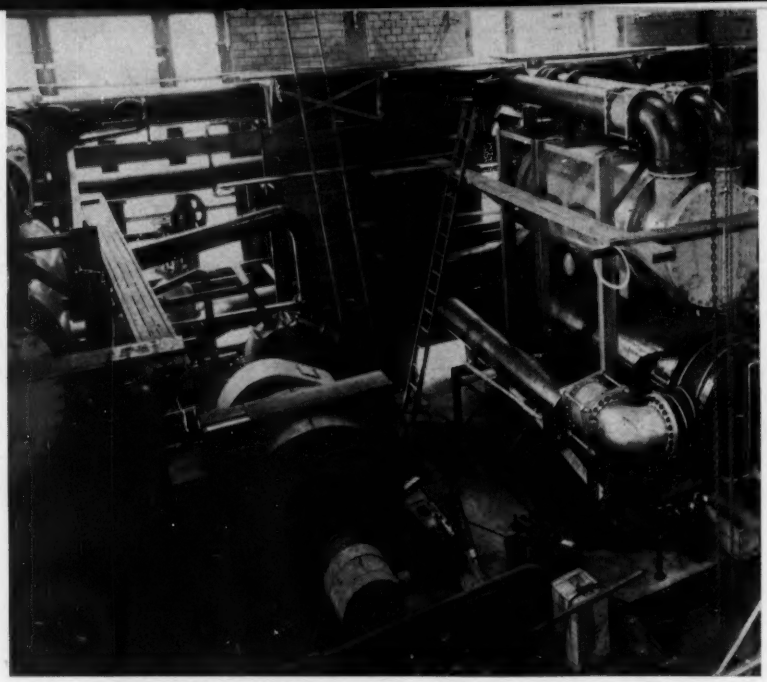
Considering different modernizing schemes has played an important role in the overall program. The Architect of the Capitol studied a plan that would have placed new machines in operation alongside existing. But the Capitol plant will no longer generate 25-cycle current needed to operate existing units. So carrying out the plan would have meant buying six 1000-hp 60-cycle motors as well as enlarging the building—at best a costly arrangement. These studies showed clearly that it would be less expensive in the long run to install new centrifugal machines in place of the reciprocating units.

HOW SYSTEM SHAPES UP

In designing the refrigeration plant, the consulting engineers removed old machine pedestals, installed new concrete pedestals with *floating* steel bases to handle new machine loads. But they made no changes in the existing pile-supported floor slab.

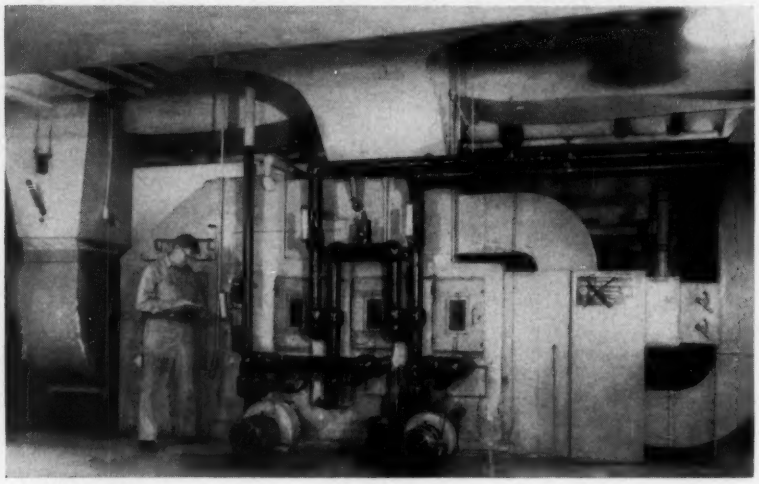
Compressors themselves can't overload their 2500-hp synchronous motors more than 3%. To boost efficiency they utilize intercoolers between their two stages. Each unit comes equipped with a standard refrigerant purge and recovery system. Also, a pump-down system permits the refrigerant charge of any one unit to be stored while operators perform general maintenance.

Synchronous-compressor motors are



FIRST TWO CENTRIFUGAL MACHINES, 2200 tons each, take about the same floor space as two 800-ton reciprocating units they replace. Motors are rated 2500 hp

Right kind of automatic controls, safety devices keep systems on the line



AIR-HANDLING UNIT in the new House Office building receives chilled water from the piping system in main distribution tunnel. Water circulates in closed system

2500-hp, 900 rpm, 4160 v, 3 phase, 60 cycle, unity power factor. Motors are rated according to NEMA standards for 4000-v design. They're built for full-voltage across-the-line starting with locked-rotor kva not to exceed 15,000 (with external field-discharge resistor connected across field circuit).

Temperature monitoring system for each motor consists of one direct-reading temperature indicator which, either by a selector switch or plug-in jacks, monitors temperature at any of the detectors.

Speed-boosting gear transmission is rated at 3000 hp. It steps up motor's 900 rpm to 4810 rpm at the refrigeration compressor.

Fabricated steel frames, completely isolated from the building by spring-type vibration isolators, support each of the four water-chilling systems. Frames were designed so natural frequency of the water-chilling system mounted on its frame is less than system's disturbing frequency.

Water chillers are shell-and-tube design, single pass. They'll operate flooded, with minimum pressure drop. Operator can use any of six shell openings to inspect the chiller, replace eliminators if necessary.

Two-pass condensers are biggest ever built for air conditioning. Waterboxes allow heads to be removed without disturbing piping connections.

Chilled water entered the Capitol's original system at 54.4 F, flowed through six chillers in series and left the sixth one at 40 F. System was highly flexible, neatly adapting itself to load swings. As load built up, operator just put another machine on the line. Operation was relatively simple.

But the latest system will handle almost twice the original load. Engineers had to boost water flow, line sizes. Pressure drop increased too. So

Capitol Air Conditioning . . . Old System Vs New

	OLD	NEW
Number of systems	6	4
Total capacity	4800 tons	8800 tons
Compressors		
Type	Reciprocating	Centrifugal
Speed	250 rpm	4810 rpm
Capacity	800 tons each	2200 tons each
Refrigerant	F-12	F-12
Motor drives		
Type	Synchronous	Synchronous
Speed	250 rpm	900 rpm
Electric characteristics	220 v, 3 ph, 25 cycle	4160 v, 3 ph, 60 cycle
Horsepower	1000	2500
Condensers		
Number per system	6	1
Gpm per system	2400 gpm	3300 gpm
Velocity	8 fps	8 fps
Pressure drop	10 psi	30 ft
Tube length	16 ft	15 ft
Diameter	16 in.	66 in.
Tubes	5/8-in. 18-gage admiralty	5/8-in. 18-gage finned copper
Water temperature (in-out)	88-98 F	86-96 F
Chillers		
Gpm per system	8000 gpm	8800 gpm
Temperature (in-out)	54.4 to 40 F	52 to 40 F
Velocity	8 fps	10 fps
Pressure drop	8 ft	15 ft
Tube length	16 ft	17 ft
Diameter	56 in.	70 in.
Tubes	3/4-in. 18-gage. admiralty	5/8-in. 18-gage finned copper
Liquid pump	7½ hp	None

the idea of four chillers in series went by the boards. Instead, the new layout features two parallel systems, each with two chillers in series. Refrigeration condensers are in parallel, as they were before.

Four unique control stations, one for each chilling system, include panel-mounted refrigeration pressure gages, pilot lights, positioning controllers and selector switches for automatic control. A duplicate set of positioning controllers and selector switches permits remote automatic operation.

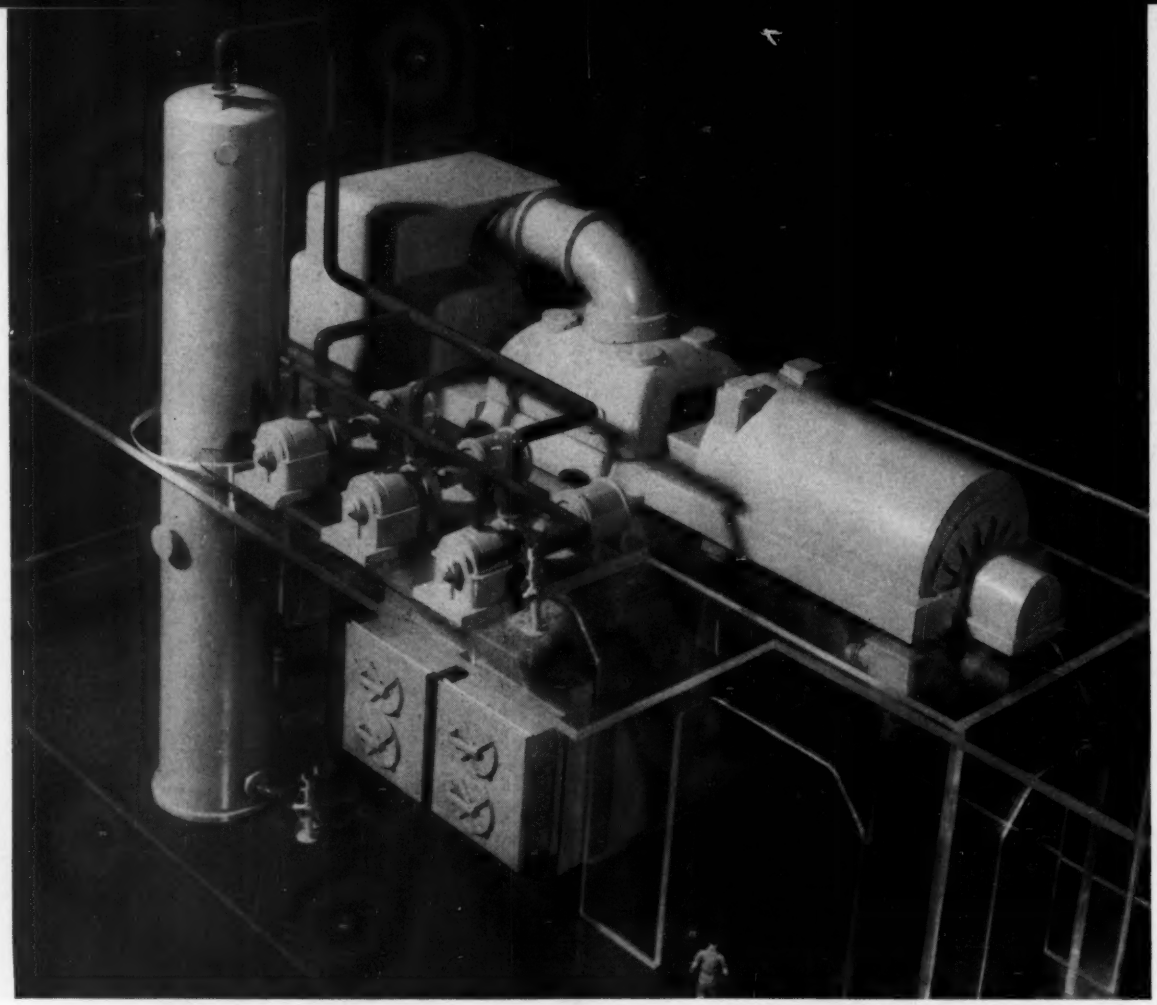
Also part of each station is (1) controls for exciting synchronous motor's dc field (2) start-stop pushbutton stations for main and auxiliary compressor motors and speed-increaser lube pumps.

Three manual-reset-type safety devices protect each refrigeration system. They're mounted close to their actuating elements, with red pilot lights on the main control panel.

COOLING TOWER TAKES OVER

Up to now, condenser water—for both refrigeration and steam—came from a pumping station on the Anacostia River. The station is about ¾ mile from the Capitol Power Plant. Its limited capacity left the engineers no choice but to replace it. After studying the economics of alternate plans they gave the nod to a cooling-tower installation near the power plant. Here's why:

Operators will be able to treat condenser water economically, control condenser-scale buildup. Scale buildup, due to water impurities, used to be a big problem. Also, Anacostia river-water temperature is moving up continually. Last summer, water temperature entering condensers soared to 91 F, substantially reducing capacity. The cooling tower will thus give Capitol Hill the capacity that it needs.



1 Eight-stage feedwater heating tower stands next to its 150-mw h-p turbine with feed pumps on main operating floor

H A Kuljian and W J Fadden Jr, The Kuljian Corporation, show how to save $10 to $15 per kw of installed cost of modern steam power plants: They combine either closed or contact-type feedwater heaters into one integrated shell or tower[1]

New power-plant idea —

► RISING PRESSURES and temperatures of steam cycles in our new plants inevitably push us toward using more and more feedwater heaters. This further complicates the feedwater and bleed-steam piping around the turbine and makes it harder to find room for the heaters.

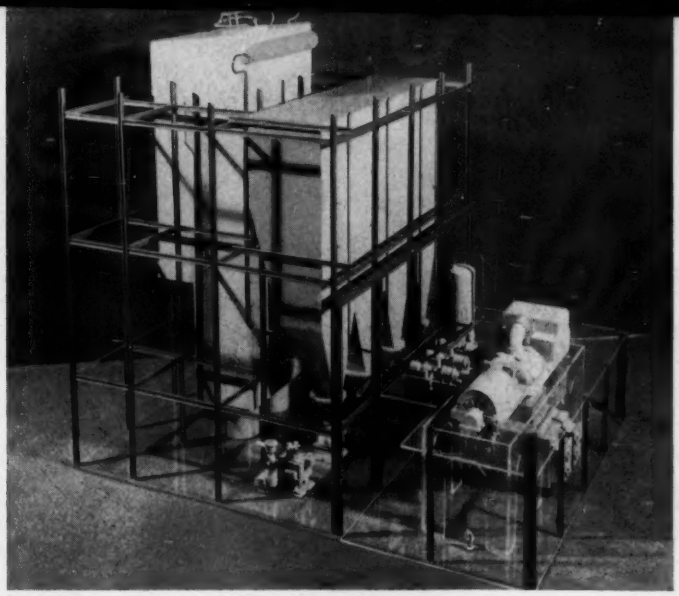
To reduce this maze of equipment, why not put all heaters in one vertical shell? Working out this idea shows that we (1) simplify the piping (2) need fewer engineering and construction drawings (3) reduce installation time and cost (4) need less floor space and building volume. These four savings add up to $10 to $15 per installed kw. This idea can be applied to both closed- and contact-type feedwater heaters for central-station or industrial turbines.

Closed heaters. Fig. 1 and 4 show a heater (Type K) with eight stages of heating that would serve a 150-mw turbine using 2000-psig 1050/1000-F steam. The heating tower has a diameter of 10 ft and overall height of 69 ft. The unit will be factory-built and tested before installation.

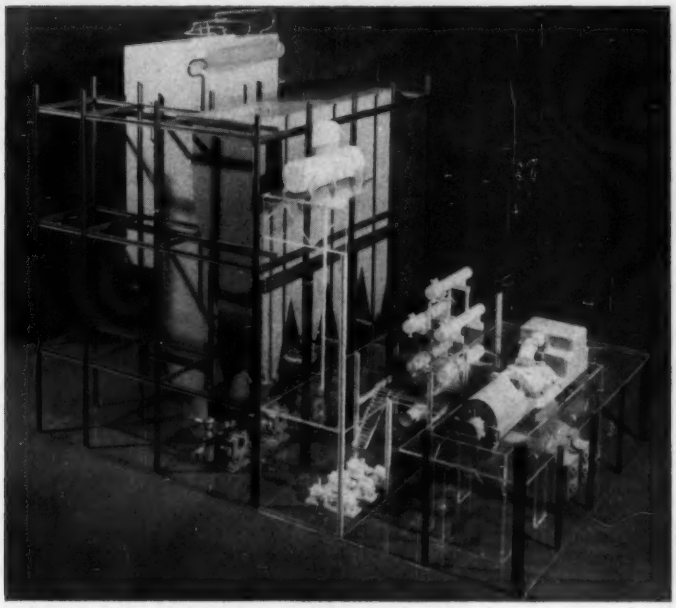
The tower stands on the condenser floor as close to the turbine as possible. Each compartment acts as one heating stage, the highest-pressure stage at the top and lowest-pressure at the bottom.

Condensate from the hotwell-pump discharge enters the inlet manifold at the tower bottom. In the first stage the condensate flows through the paralleled spiraled tubes, Fig. 5, to the outlet manifold. The outlet manifold is integral

[1]Abstract of ASME Paper No. 56-SA-34, which was presented at Cleveland, Ohio on June 19, 1956.



2 Comparing heating-tower installation with conventional multiple - shell heater arrangement in Fig. 3 shows new scheme uses less space for auxiliary bay



3 Conventional 8-heater arrangement needs more space and piping (not shown) and usually places deaerator near roof with feedwater pumps in basement

feedwater heating towers

with the inlet manifold of the second stage. The partly heated condensate flows up through this joint manifold to enter the spiral tubes of the second-stage heater and on to the next manifold.

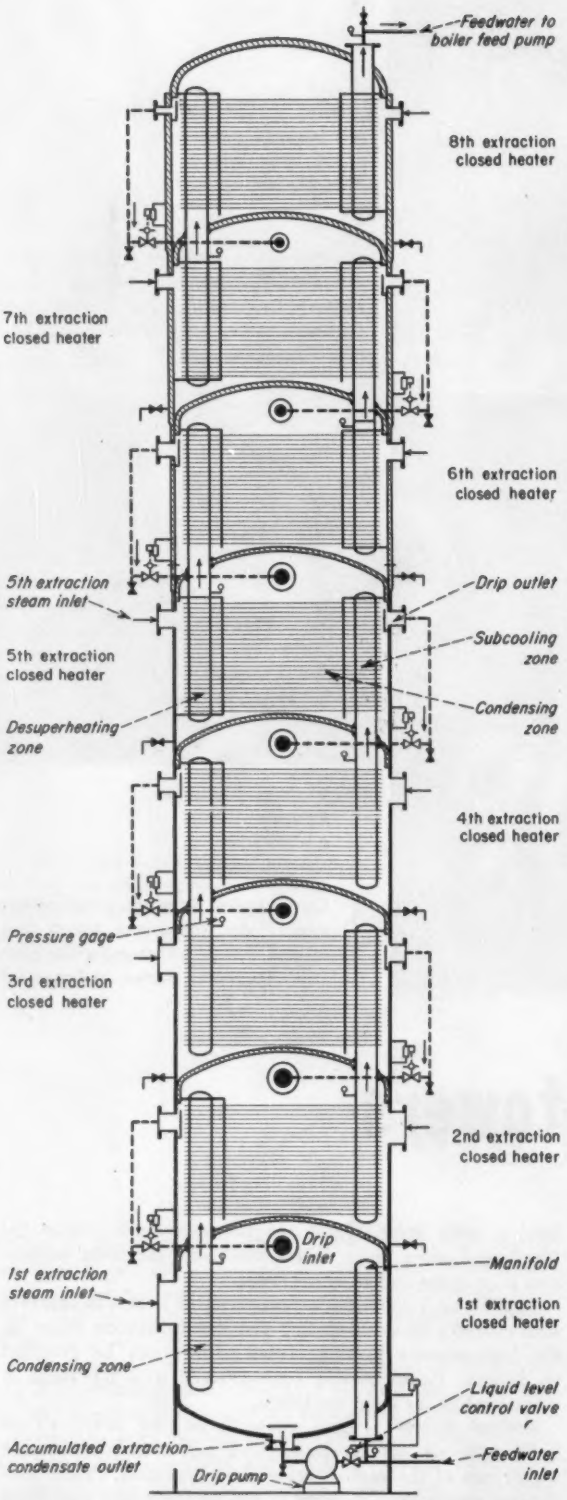
This series of flows from manifold to spiral tubes to manifold, etc, takes place to the top of the tower. From here the heated water goes to the feedwater-pump inlet.

The manifolds between heating sections are welded to the partition plates separating the stages at one diameter only. This allows the manifolds and spiral coils to expand freely without creating any appreciable stress.

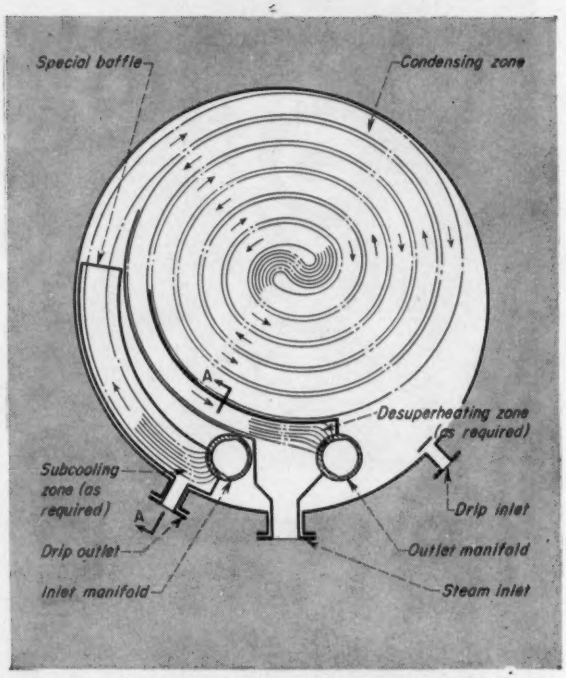
Bleed condensate cascades from the highest-pressure section at the top successively through all sections to the lowest-pressure at the bottom. Control valves maintain condensate level in each stage. From the lowest-pressure section the bleed condensate pump forces water into the main condensate inlet at the bottom of the tower.

Fig. 4 and 5 show the arrangement of baffles to increase heat recovery by drain-cooling and desuperheating zones, in the high-pressure heating stages. These can be provided as desired. Heater section vents cascade from h-p stage in series back to the main condenser.

Contact heater. Fig. 7 shows a heating tower (Type K-F) with six contact stages and one closed or surface stage; one of the contact stages is a deaerator. Main condensate enters the l-p stage at top of the tower and flows by gravity through receiving and discharging locks to the higher-pressure stages below. Heated feedwater leaves the



4 Eight-stage feedwater heater takes in main condensate at bottom and discharges to boiler feed-pump suction at top



5 Tubes for heating sections in spiral form give maximum flexibility, may be baffled for cooling or desuperheating

receiver at tower bottom to enter the boiler feedwater-pump suction.

The locks between stages operate as follows: One lock of a pair open to the stage above receives heated water by gravity after it falls through the trays. A vent port in the 4-way valve controlling the locks equalizes pressure in this lock with the stage. The other lock of the pair discharges water it has accumulated to the h-p stage below by gravity flow. Its vent port connects to the stage below, equalizing the pressure.

When one lock fills, the other has emptied. The 4-way transfer valve automatically operates to interchange the functions of the locks so the full one discharges to the h-p stage and the empty one receives water from the l-p stage. Transfer-valve operation frequency varies with feedwater flow. This arrangement eliminates heater pumps ordinarily needed with contact heaters.

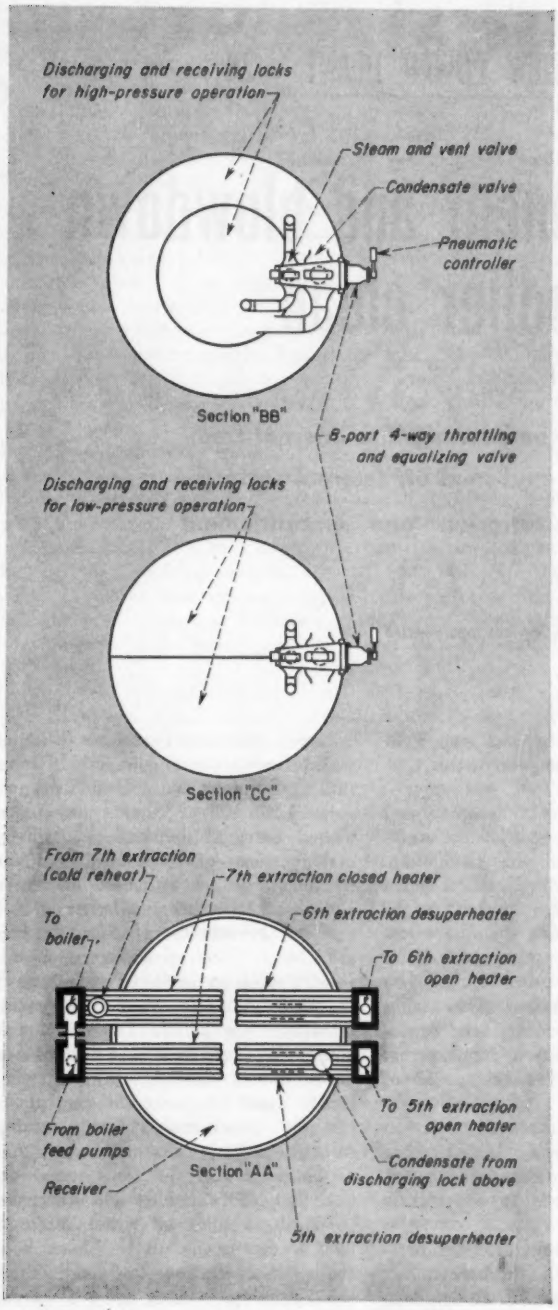
The receiver is held at the same pressure as the highest extraction stage. Bleed steam for this h-p stage is first desuperheated in the closed heater and enters the receiver at about saturated condition. The condensing zone for this closed heater is completely open to the steam space in the receiver, so its condensate joins the water in the receiver.

Since receiver water will be under the pressure of the h-p 7th-stage bleed steam, there is always a positive suction head on the boiler feed pumps.

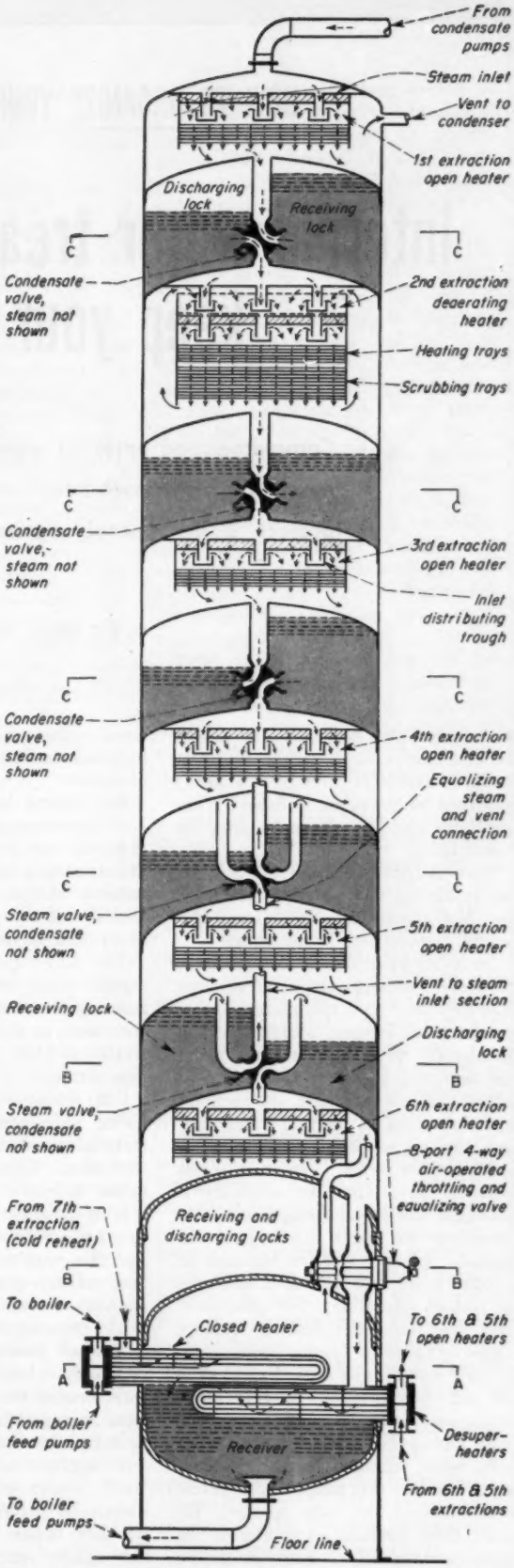
The receiver contains two desuperheaters, one each for 5th and 6th extractions. The 7th extraction closed heater mounts inside the receiver. Boiler feed-pump discharge flows through the tubes of the 7th-stage heater.

Control system for the K-F heater maintains a practically steady flow to each heater stage for a given turbine load. This minimizes fluctuations in extraction-line pressures. Controls for each stage have three elements: (1) primary demand response (2) correction for head variation (3) correction for flow to succeeding stage.

Efficiency. The K-F heater when working with a 150-mw



6 Lock arrangement for contact heater sections depends on steam pressure; receiver uses some heat-transfer surface



7 Seven-stage contact-type feedwater heater uses six open sections. Boiler feed pump takes water out of receiver

turbine at 1800 psig, 1000/1000 F, and 1.5 in. Hg has a better heat rate than a set of conventional closed heaters working with the same turbine. Heat-rate improvement runs about 0.425% better. This is based on: (1) 3% pressure drop from turbine to extraction flange (2) 5% pressure drop extraction flange to heater (3) inclusion of boiler feed-pump power (4) use of 900 lb per hr ejector steam (5) 0.5 psig H_2 pressure in generator (6) zero makeup (7) 135-F leaving temperature of ejector condensate.

HOW TO ORGANIZE YOUR NEW POWER PLANT — 24

Internal water treatment and blowdown keep your boiler clean

Complementing external water conditioning, the internal treatment and blowdown keep scale and mud off internal surfaces, protect boiler metal against corrosion and embrittlement

By D C SWIFT, *Ebasco Services Incorporated*

► ACCUMULATED SCALE OR MUD acts as an insulator inside a boiler. Water or steam is unable to carry off heat being absorbed by the tubes or drums. Temperatures rise and sooner or later the metal fails.

Even if boiler does not fail at once, the insulating effect of scale results in less heat absorption. This often causes several percent loss in efficiency.

So boiler water should be conditioned to prevent deposits on metal surfaces. The treatment must also protect against corrosion of internal surfaces or embrittlement of highly stressed metal. As operating pressures rise and heat-absorption rates increase, the need for, and difficulties of, internal water treatment are augmented.

Why scale forms. The main reason scale forms is that the solubility of dissolved calcium and magnesium salts decreases as water temperature increases. When a solution becomes supersaturated, enough salt precipitates to restore saturation. The precipitate may drop on boiler heating surfaces. There it bakes to form a scale.

Scale may also be formed when overall salt concentration is well below saturation level. Local areas of high heat absorption combined with sluggish water circulation may produce steam bubbles that temporarily prevent water cooling the tube surface. Beneath these bubbles, water film on the metal surface dries. Salts crystallize out directly on the hot metal surface. Good water circulation at points of high heat input helps prevent this type of scale.

But once a boiler is designed and built it is better to condition the water than try to change the circulation. Maintaining reasonable solids concentrations always helps prevent scale. Deposits at boiler "hot spots" are less likely with relatively pure water.

The purer the feedwater, the less rapidly solids accumulate. This makes internal treatment easier, less expensive, and is the reason for external treatment (see articles 22 and 23 of this series).

But almost any external treatment leaves some residue of scale-forming material dissolved or suspended in the feedwater. This tends to concentrate in the boiler.

It is possible to operate high-pressure boilers without internal treatment. But this requires careful attention to keep makeup quantity low, purity high, and to prevent condenser leaks that would contaminate the feedwater.

Internal treatment. Usual practice adds sodium-base salts that react with scale-forming materials to produce calcium or magnesium precipitates. These do not stick to boiler surfaces. Instead, they agglomerate and drop out into lower, cooler portions of boiler or waterwalls for removal by blowdown. Or they remain in suspension; then they can be removed by surface blowdown in the boiler drums.

Excess treatment chemicals in boiler water force softening reactions to a rather complete end. This also provides a reserve to combat any unexpected entry of hardness caused by maloperation of external feedwater treatment, or contamination of return condensate entering the boiler.

Boiler blowdown. If steam leaving a boiler is pure, all dissolved or suspended solids in the feedwater, plus any chemicals added for internal treatment, remain in the boiler. They gradually concentrate, unless removed by blowdown. Boiler blowdown thus is essential to water treatment and control. It removes precipitated scale-forming salts and soluble salts or minerals that do not form scale at lower concentrations but may cause trouble otherwise.

Blowdown may be either intermittent or continuous. But it must hold solids concentration low enough to avoid priming, foaming and scale deposition. Amount of dissolved solids varies in different boiler parts. It is usually greatest in the drum where returns from heavy-steaming waterwalls enter and much steam is released.

It is desirable to blow down the most highly concentrated water. This keeps heat loss and makeup at a minimum. Usual and best practice puts a continuous blowdown line in the main steam-releasing drum, three or four inches below normal water level. Line is perforated with small holes to allow water entry equally across boiler width.

For accurate blowdown control, use a flow-control or similar valve, suitable for continuous throttling with flow characteristic corresponding to valve stem movement. Back up with one or more tight-closing valves.

Arrange blowdown valves in tandem. Usually, use outside valve for throttling and inside one for tight shutoff. Then outer valve may be repaired if necessary while boiler is in service.

Ordinarily, blowdown valves may operate any time without impairing boiler-water circulation. But never open waterwall blowdown valves full while a boiler is steaming at any considerable rating. Circulation in the walls may be impaired, causing overheating and burnout where tubes are exposed to extreme furnace temperatures.

In industrial boilers with 3 to 100% makeup, it may not be economically possible to distill makeup water. A large amount of solids may then enter the boiler, even if the water is chemically treated.

Under some treatments, a heavy sludge is thrown down. Remove this from lower waterwall heaters by blowdown. If possible, blow down while boiler is banked or at low rating. If not possible, a small bypass line, tandem-valved, around main blowoff valves, limits blowdown rate so waterwall is not starved.

For heavy blowdown, it pays to invest in a heat exchanger or flash tank that reclaims part of the heat.

Priming and foaming are closely related to the concentration of dissolved solids. National Association of Boiler Manufacturers recommends limits for maximum concentrations.

With higher pressures, lower dissolved-solids concentrations are desirable. This is also true for silica. With high-pressure low makeup boilers, hold silica concentration below 5 ppm. If either silica or total solid concentrations exceed desired values, reduce by boiler blowdown, assuming makeup water is of good quality.

Internal-treatment chemicals vary with feedwater impurities and operating pressure. Central-station units with distilled makeup normally use some form of phosphate salt. You get best reaction and floc precipitation at pH above 9.5. If constituents in the water are likely to develop high alkalinity, use acid salts like monosodium phosphate or sodium metaphosphate. Disodium phosphate is nearly neutral in its reaction and is usually the most economical phosphate. To increase alkalinity, use trisodium phosphate or other alkaline material like soda ash or caustic soda, along with disodium phosphate.

For best protection against internal corrosion, keep pH above 10.5. But if alkalinity is too high, tendency toward priming, foaming and carryover increases. A successful range is usually from 10.5 to 11.0.

With pH above 10.0 and phosphate concentration above 15 ppm, you get almost complete hardness removal. A phosphate ion concentration of 30 to 40 ppm gives some margin for chemical loss. You can substitute potassium salts for sodium phosphates in water conditioning. They are more expensive, but theoretically have a more complete reaction and precipitation than sodium compounds.

Soda ash is often used to remove hardness in boilers operating below 300 psig. Above this pressure it decomposes, releasing CO_2 in the steam; this may corrode condensate-return lines when steam condenses and CO_2 is reabsorbed in water.

Sludge thrown down by the reaction of the carbonate ion with the calcium or magnesium hardness in water is somewhat denser and less sticky than phosphate sludge. When removing large amount of hardness, as in a high makeup boiler, carbonate treatment is often successful. Tannin and other organic and inorganic materials help maintain sludge in a fluid form readily removed by blowdown.

Sometimes a combination of phosphate and carbonate treatment is best. The carbonate concentration depends on boiler pressure. Above 400 psig, concentrations above 20 or 30 ppm may break down so rapidly that alkalinities rise undesirably high, up to 11.5 pH.

Sodium sulfite is another chemical normally used in internal boiler-water treatment. It reacts with dissolved oxygen to form sodium sulfate. Amount required depends on amount of dissolved oxygen in the incoming feedwater, and also on amount of breakdown. This latter phenomenon apparently depends on boiler pressure and circulation. A concentration of 15 to 30 ppm of sodium sulfite is usually carried; the lower value seems to result in a lower breakdown rate.

The sulfite reaction with oxygen affects the sodium sulfate concentration. Ordinarily low concentrations of this salt cause no trouble. In fact, they seem to help make turbine-blade deposits less sticky, easier to dissolve.

Also, maintaining a ratio of sodium sulfate to total alkalinity in excess of three to one is believed to prevent caustic embrittlement. This is known as the ASME ratio. With boilers operating below 200 psig, ratio may be reduced to two to one.

Chloride concentration in boiler water is usually determined in routine control checks. Sodium chloride is very soluble, so there is little danger of scale. But if total dissolved salts is too high, danger of priming and foaming increases, and the quantity of solids carried along with wet steam is greater.

When plants use sea water for condensing, chlorides in the boiler may increase rapidly because of a condenser-tube leak. A similar possibility exists when evaporator feedwater or cooling-tower makeup contains a high percentage of chlorides. So knowledge of chloride concentration and control by blowdown is desirable.

Total solids concentration can be checked by determining conductivity of a boiler-water sample. A rough constant of 0.5 times the conductivity of water, expressed in micromhos per cu cm, approximates total solids dissolved in the water.

Each of the ions usually dissolved in water has a different conductivity constant; hence the constant for a given water varies, depending on its character. Adding the hardness, total alkalinity, chlorides, silica sulfates, sulfites and phosphates expressed as sodium compounds closely approximates total dissolved solids and establishes a more correct constant to use with conductivity determinations.

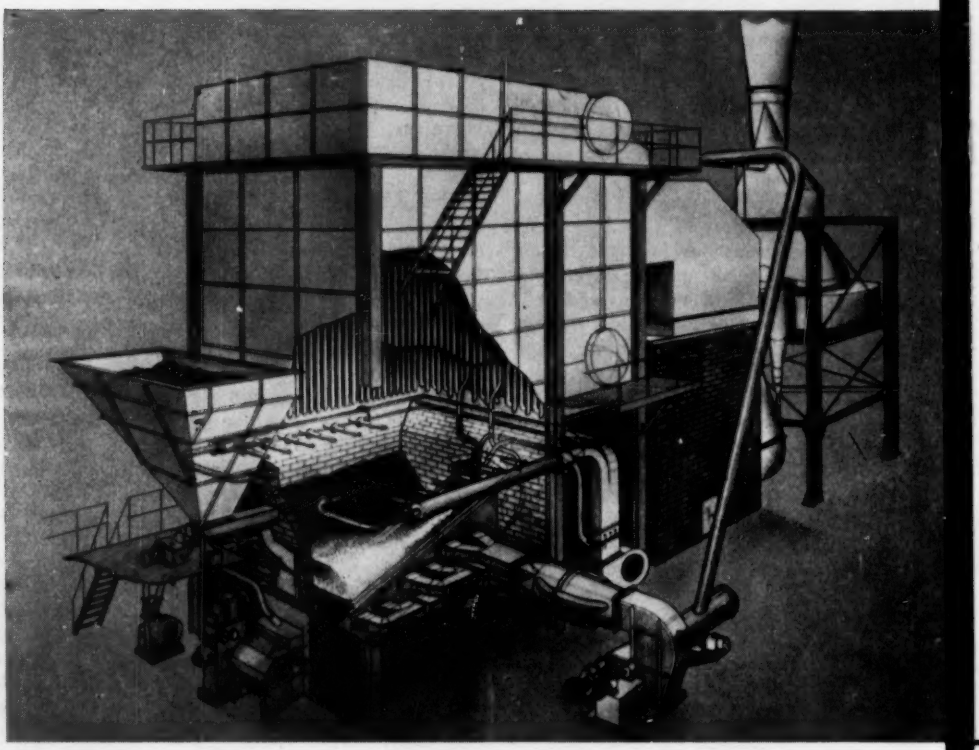
For an accurate figure, evaporate a given quantity of water to dryness and carefully weigh the residue.

Embrittlement detector cells help determine water's tendency to make boiler metal brittle. A sample of the metal cut to predetermined size is placed under heavy stress in the cell. Then water at boiler temperature is continuously circulated through it. Operator inspects the metal sample at frequent but gradually lengthening intervals for signs of failure. If failure occurs, water conditioning is not preventing caustic embrittlement, and corrections are in order.

Determining boiler-water hardness shows the presence of scale-forming calcium or magnesium compounds. Check hardness with a standard soap solution or the versenate colorimetric

(*Continued on page* 189)

By ALBERT GODEL*



1 Artist's drawing shows modern-design boiler in service in Macon, France. Supplying the city heating system, boiler capacity is about 40,000 lb per hr

Now, fluidized firing of cheap fuel

This new technique handles any coal 0 to ⅜ size, of any moisture or ash content. It promises to slash fuel cost, operation and maintenance expense

► POWER ENGINEERS, always aiming at lower operating cost, see possibilities in a radically new combustion technique. Developed in France, the process could mean big cuts in fuel bills.

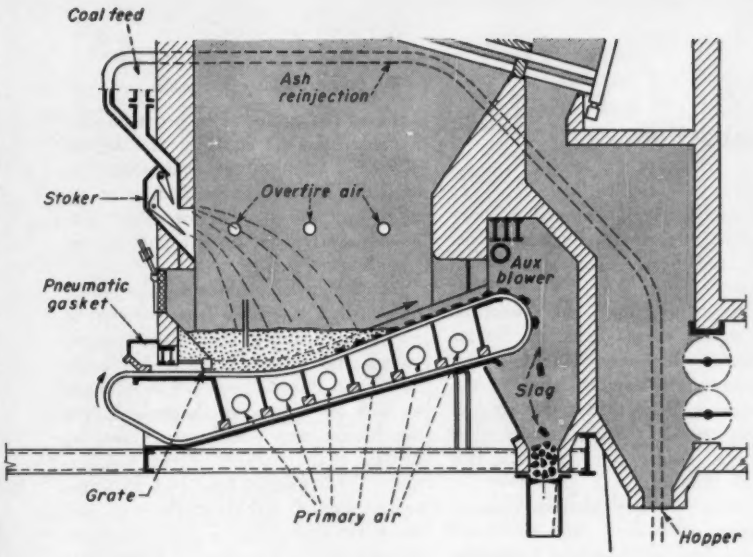
Differing substantially from conventional stoker or pulverizer methods, it provides for combustion of coal fines in what virtually consists of a boiling fluid bed. Test runs were made with varied types of anthracite and bituminous having high ash and moisture content. Other tests burned middlings and sometimes even slimes. A unique method of continuous slag removal from the fluid bed resulted in clinkers relatively free of unburned matter.

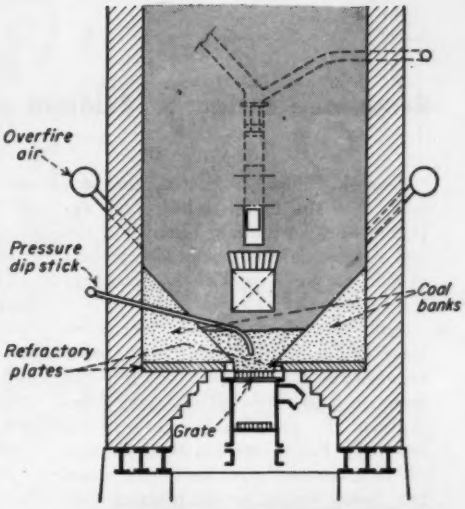
Simplified technique is this: Coal (0-⅜ sizes), continuously fed by spreader stoker, or compressed air, dries, distills, ignites and quickly becomes part of the fluidized bed. Primary air from below the grate, plus release of combustible gas, keeps the burning fuel bed in a uniform state of "boiling suspension" above the grate. Since a steady primary-air pressure would carry away some of the fines before complete combustion could occur, intermittent air (pulsation) is used. This not only prevents flyaway of very fine particles, but also gives "boosts" to heavier particles trying to settle to the grate.

Furnace floor incline from front to rear at about a 10-deg angle gives a graduated fuel-bed depth. Deepest part, at front of furnace, is about 2 ft. A curved traveling grate, less than one fourth as wide as the furnace, has an incline of about 18 deg. Grate area is approximately one tenth that of a conventional grate of equal capacity. Emerging near the fuel-bed rear and protruding from the combustion chamber, the grate discharges slag. An auxiliary blower at the discharge end subjects the slag to air blast, blows small unburned particles back into the fluidized bed.

First industrial furnace under older-type long-drum boiler is shown in Fig. 2 (longitudinal section) and Fig. 3 (transverse section). Little attempt was made to develop boiler efficiency. Main purpose was accumulating and correlating data on furnace performance. With grate moving in direction shown by arrows, spreader stoker feeds the furnace with fines. Feed must be as even as possible over the free surface of the fluidized layer. Since the grate is not as wide as the furnace, refractory plates bridge the distance between grate and furnace walls. Coal fines are heaped, as "banks," at a 45-deg angle on the plates. These banks are not part of the fluidized bed, but serve

*President and General Manager of the Activit Corp, 66 Rue d'Auteuil, Paris, France. M. Godel's article is a condensation of his paper presented before the Society of French Engineers.





2 Longitudinal section, *above:* continuous slag discharge by traveling grate. Suspended fuel bed decreases in depth toward rear of furnace

3 Transverse section shows relative width of grate to furnace; 45-deg banks of coal protect walls and floor, give needed shape to fuel bed

4 Photo, *at right,* shows furnace brickwork after six months' service. Clearly outlined areas protected by coal banks are in good condition

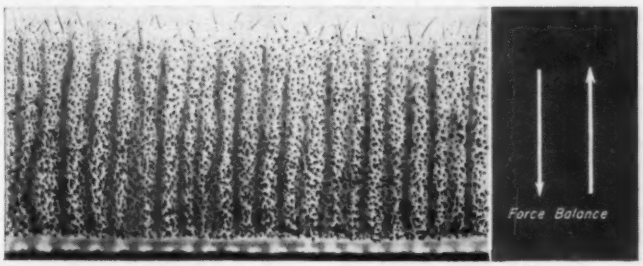
the important double purpose of preventing slag formation on furnace walls and protecting walls and floor from high temperature.

At startup, the banks are built by shoveling coal onto the plates. During operation, coal fed partly on the fluidized bed and partly on the banks constantly replaces fines burned from the surfaces of the banks. The fluidized bed conforms to grate width at the bottom, then widens to near full furnace width at the top of the banks. A special impeller (not shown) feeds pulsating primary air through the air boxes under the grate. Air pressure diminishes from 7 to 1 in. water along the grate as fuel-bed depth decreases from front to rear of the furnace.

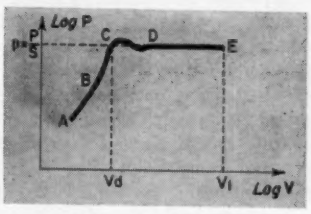
Temperature of the fluidized bed may vary from 1800 to 2200 F; clinkers forming are churned by the continuous agitation and pulsation of the fluidized bed. When the clinkers get too big to remain in suspension they sink to the surfaces of the banks and slide down to the moving grate. As the grate carries them toward discharge, they're subjected to a sorting and sifting action, further burning out any coal particles. This, coupled with the action of the auxiliary blower, reduces coal content of the clinkers to not more than 5%.

(Turn page)

Fluidized combustion... how it works



Fluidization, briefly, consists of keeping burning fuel particles in stable suspension in high-velocity gas. They form in a hydrostatically balanced layer, much like a boiling liquid. The drawing shows a fluidized fuel bed suspended, partly by primary air, mostly by released combustible gases. Lift force on gases is balanced by pressure (weight) of fuel particles, indicated by force diagram at right of drawing.



Log curve plots gas velocity vs fuel-bed pressure. Velocity increases along *DE* without increasing pressure. *AB* is laminar flow. Then velocity approaches critical and *BC* is turbulent flow. *CD* is unstable phase until equilibrium is reached at *D*. Fluidization starts, continues through *DE*.

From idea to fact... fluidized combustion

Though violently agitated, the free surface of the fluidized bed stays approximately horizontal. Fluidity of the bed requires use of pneumatic gaskets around the entry point of the grate into the furnace.

Ignition of fuel particles means release of combustible gas. In the area between the toes of the banks this gas tends to have low initial velocity because of the pressure (weight) of the fuel bed. But as the gas rises through the bed, burning particles release more gas, losing weight in the process. Gas velocity increases as the fuel-bed pressure decreases. As the gas leaves the surface of the bed, velocity approaches critical, flow changes from laminar to turbulent. Result: Some of the very fine particles, attaining "flight velocity," are carried along and burn with the gas in the overfire air zone. Remaining mass of particles in the fluidized bed stays in suspension during combustion.

Gas-velocity range, or variation, is important. Since all fuel particles are not the same size, or of the same density, gas velocity is limited by the "flight rate" of the particles. Low velocity would mean particles settling, burning as a stationary layer on a conventional grate. Too-high velocity would give the particles "flight velocity," causing the fuel bed to literally fly away. In actual operation, some unburned particles escape from the furnace area, but they're recovered at the base of the hopper under the stack and recycled to the stoker.

Fuel-bed depth must be constant for a given furnace performance. In first industrial setup, a gage sensed furnace pressure at the grate through a cooled dip-stick connection. The gage transmitted impulses through a compressed-air pilot-relay, which actuated a speed-changer controlling the stoker. This eliminated any need for adjusting the fuel feed manually. Change in combustion rate meant manual control of primary and overfire air, but steam-pressure control of air supply would have given completely automatic firing if desired.

Furnace startup is relatively simple. The coal banks are built with shovels to a 45-deg slope on either side of the grate. With the grate at a standstill, blown with low-pressure primary air, a wood fire is kindled. Small amounts of coal are shoveled onto the grate, still keeping low-pressure air until the coal is completely ignited. As primary air is slowly increased, fluidization occurs at red heat. Then stoker feed takes over.

Temporary shutdown, for about 36 hours, merely means banking. No relight is necessary. By using low-pressure primary air about 45 minutes, the bed recovers and fluidization starts. If firing interruptions are only of one or two hours, fluidization starts in less than one minute.

Discovery of the phenomenon of fluidization isn't new, but it wasn't developed into an industrial technique until 1943. Almost simultaneously, it appeared in the U.S. for producing high-octane gasoline and in Germany for producing synthetic fuel. Its application to coal combustion stemmed from research work, in France, on production of activated carbon.

Considerable research effort was made to study the characteristics of fluidized layers. The work definitely establishes that the layers have similarities with liquids. Internal particle movement of the layers, for example, is similar to movements of molecules that constitute fluids.

Some feeling exists that the phenomenon of fluidization has no counterpart in nature, that it can be produced only artificially. It is true that special conditions must be created to study layers of particles in fluidized phase. But sometimes such conditions may be accidentally fulfilled in nature. Study of the curious action of certain volcanic eruptive phenomena prove this. The origin of such cataclysms appears to lie in the existence of powerful masses of high-temperature volcanic dusts and rock fragments. These move violently in the form of a dense fluidized layer.

A well-known example is the eruption of Mt. Pelee that destroyed St. Pierre, Martinique, in 1902. Dense clouds of volcanic matter flowed down the slopes of the mountain. Speeding more than 60 miles per hour, it suddenly covered the city with a thick layer of ashes. This was simply a torrential flow of a fluidized layer.

Developing the combustion technique meant solution of some tough problems. Examples: Segregation of nonuniform particles cut down the available range of velocity variation through the furnace length. Slag formation in the fluid bed clogged grates and built up on furnace walls. Uniform ash deposit on the grate, as in producing activated carbon, couldn't be accomplished. Attempts at systematic circulation (a fast horizontal flow of the fluid layer along a narrow grate) produced spotty ash deposit and an unstable fire.

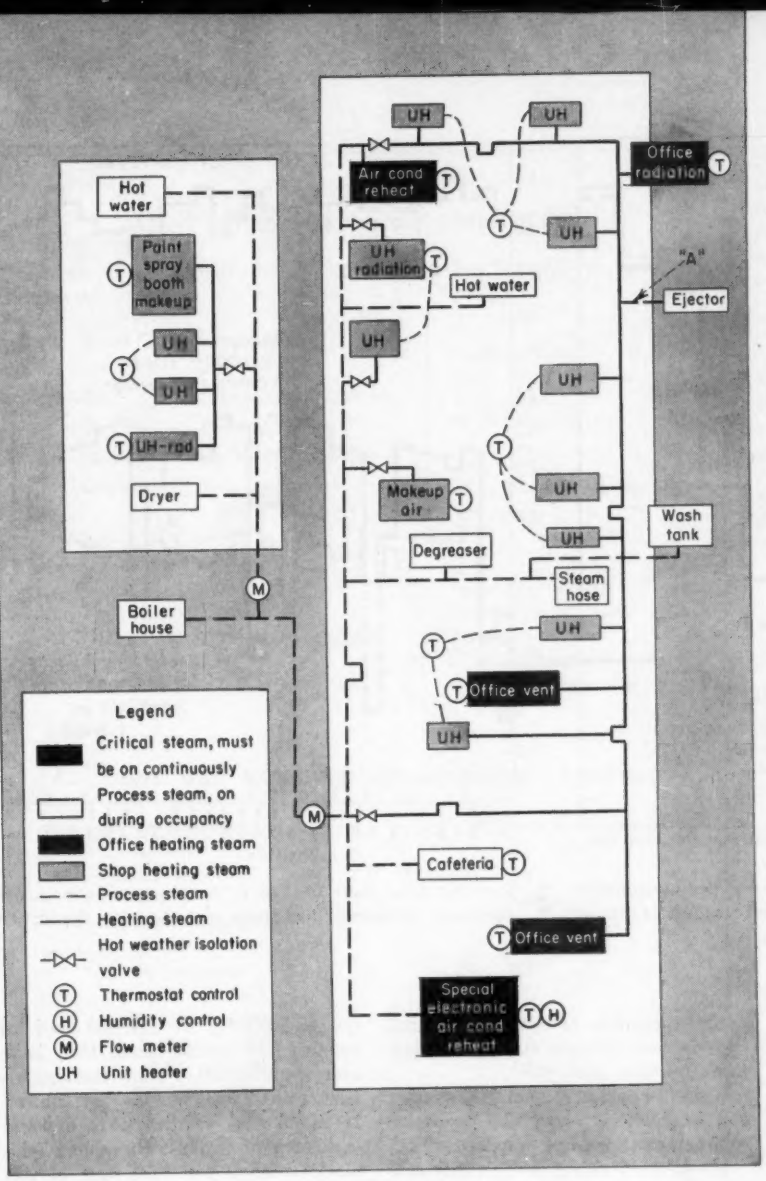
Solving these problems came slowly but surely. A change from constant to pulsating primary air reduced segregation and gave the desired velocity variation. Pulsations could be changed at will by a special shutter between the blower and windboxes. Changing furnace shape reduced segregation further. By having a fluid bed of trapezoidal section, flared at the top, primary air turbulence is greater at the bottom, prevents settling of heavy fractions.

Self-cleaning grates eliminated slag clogging. Watercooled and equipped with mechanically driven sliding bars, the grates extracted and discharged slag. But the grates cooled the fluid bed too much. Finally, experiments with pyrometers connected to thermocouples attached to grate bars proved watercooling wasn't needed. Fluidization of the fuel bed plus the primary air through the grate, even during startup, kept grate temperatures low enough to prevent any damage. This led to the grate development shown in Fig. 2.

Furnace walls and floor had watercooled refractory during tests to learn how slag formed in a fluid bed and how it could be extracted. The tests showed that ash particles agglomerated like butter particles when churning cream. But they didn't agglomerate with coal particles. This bore out the theory that the fluidized bed could be likened to a *dense liquor* in which slag settling would take place. But when it did, it coated the furnace walls. Admittedly in a blind alley at this point, an experiment with the coal banks to replace watercooling and refractory proved to be the answer. The banks not only protected the walls and floor, but also helped slag collection on the grate. Also, they provided in a very simple manner the desired trapezoidal shape.

Furnace and boiler were inspected after six months' service. Raw-water feed had caused some scale in the boiler. There were no fireside deposits. Furnace wall and floor areas protected by the banks were undamaged. Good condition of brickwork above the banks showed effectiveness of furnace temperature control by overfire air and flue-gas reinjection.

(*Continued on page* 186)



1 One-line diagram of heating system may indicate points needing piping modification. Here the ejector at *A* should be reconnected to process main

4-point program for power-service economy

LAST PART OF REPORT

By **ALMONT KOEPF**
Product Development Engineer
Kaiser Aluminum & Chemical Sales Corp

► IN THE FIRST PART of this report (May, p 94) we discussed fuel and powerhouse economy. Now we show how savings in consumption and administration help improve power services, increase overall company profits.

CONSUMPTION

While cost savings by improving boiler combustion efficiency are obvious, distribution efficiency is more difficult to determine. It is an intermediate step in the total system and the minimum required consumption rate is generally unknown.

The first step in utilization control is to approximate the required minimums. The minimum performance rates vary with each facility, but can be set for any existing or projected plant by delving into past records of that plant or comparable plants.

Both process and personnel requirements must be considered. Process needs include water, compressed air, gas, steam or water heat, cooling, electrical power. Personnel requirements satisfy environmental standards and include lighting, water, heating and cooling. Table 1, p 91, shows the units to use for comparative analysis.

Note that heating and cooling loads for personnel comfort are based on degree days. A degree day is the temperature difference between a base standard and the mean outside daily ambient. The base-standard heating temperature represents the point where no supplementary internal heating is required. Office-type occupancy is based on 65 F, while factory occupancy is based on 55 F. Your local weather bureau can give you the degree days for any period.

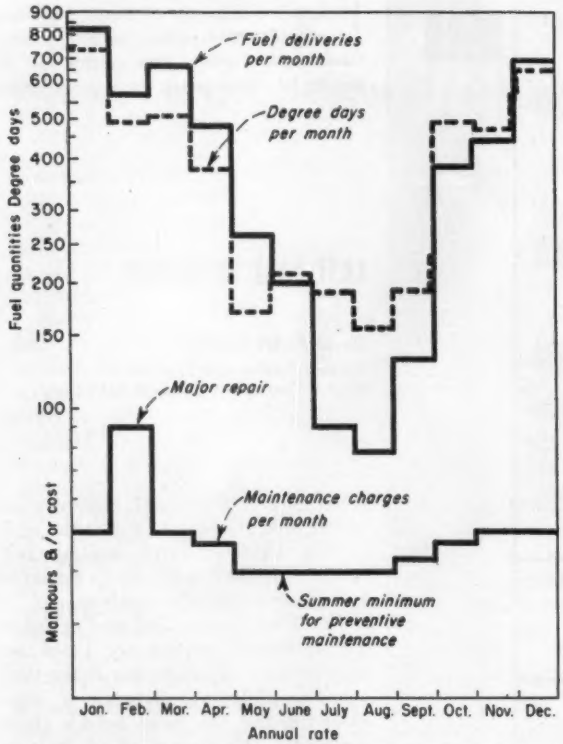
Constants in Table 2, p 91, give a base against which you can compare steam consumption in your plant. An alternate method of establishing the base comparator is to choose a target of 50 to 75% of the past year's use.

The first step in any conservation program is to secure a complete set of single-line utilization drawings of all utilities. These drawings should show the distribution frame and locate all consuming equipment. Omit piping and instrument details to present the picture more forcefully. Identify controls by simple symbols. Use a code to distinguish process from environmental comfort equipment, and to show the operational period of each. Studying the drawing may indicate distribution rework to simplify the system.

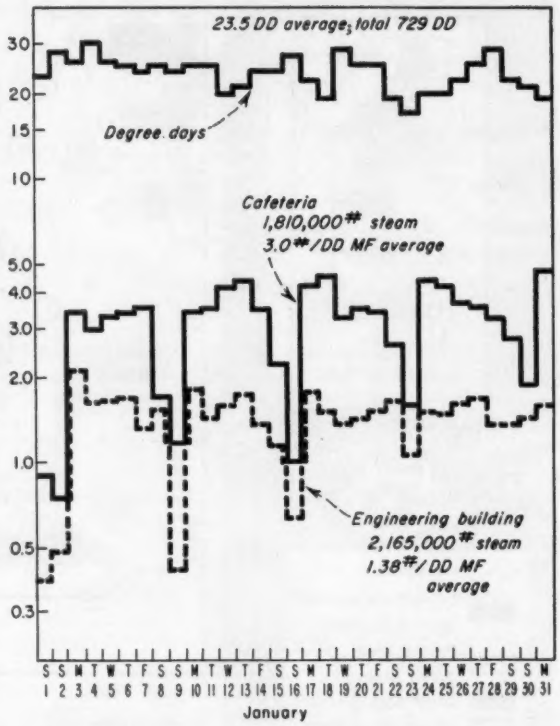
The heating system (steam or hot water) is the most critical. Single line drawing in Fig. 1 shows a typical heating system. Condensate lines are assumed to parallel the steam lines. Note that reconnecting the ejector at *A* to the process main would clear heating mains of process requirements.

When putting in new piping, keep process and heating systems separate.

Adequate metering is essential for


Fuel quantities Degree days
Manhours $ /or cost
Fuel deliveries per month
Degree days per month
Major repair
Maintenance charges per month
Summer minimum for preventive maintenance
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.
Annual rate

2 Monthly record of gross fuel deliveries and operational maintenance costs show important plant trends at a glance


23.5 DD average; total 729 DD
Degree days
Cafeteria 1,810,000# steam 3.0#/DD MF average
Engineering building 2,165,000# steam 1.38#/DD MF average
January

3 Running daily chart of fuel or heat consumption guides operating personnel; use units that describe the action

regulating consumption. There is an economical limit to this so, as a rule of thumb, provide a meter for each logical system subdivision where the total annual heating cost exceeds ten times that of the installed cost of a meter, or where heating costs are roughly over $5000 annually. Usually the savings pay for the meter rapidly.

In any case, install at least one meter for each major system.

In small plants, approximate the consumption by assuming a fixed boiler efficiency and using the fuel rate to determine the consumption heat rate. The comparison figure then reduces to unit of fuel per degree day per thousand cubic feet.

Windows, doors and other openings are major sources of excessive heat loss. Keep windows closed during heating cycles. In fact, heat should be removed when occupants open windows. Equip factory doors with heat to blast-temper the incoming air.

Controls are the heart of the distribution system. Most controlled systems operate on a room thermostat, but a surprising number are still manually controlled. There is no gain in continuing manual control. Also, a single thermostat is at best only partly effective. Heating and process systems need anticipation or combined control. Process control might employ temperature, pressure, time, etc.

Inside temperature, outside weather and condition of occupancy determine environmental control requirements.

Inside temperature is ordinarily controlled by room thermostats. But if small temperature differentials can easily be tolerated, the control can be set and calibrated on the basis of outside weather alone. This is common practice in office buildings.

Outside weather affects heating requirements, of course. As outside temperature rises, the internal heat needed decreases proportionately. No heat is needed at an outside temperature 5 to 15 degrees below desired room temperature. Ideal compensation for this variation is heat-source temperature modulation. But usually the combination of inside thermostat and outside off-on override is satisfactory.

When outside humidity is extremely low, the inside-air dryness aggravates the effect of drafts and differential temperatures. Inside comfort temperature must usually be increased. Sometimes it is advantageous to install humidifying equipment.

Condition of occupancy changes during the 24-hour period. When most people leave for the day, the need for comfort heat is eliminated. Only hold-over temperature to allow morning reheat prior to occupancy is required. If mechanical ventilation is unnecessary, turn off all fans. Overriding 7-day clock switches can take care of this.

Environmental control should combine the effects of time and of inside and outside temperature (plus effects of wind and radiation in some cases). For economy, combine the automatic controls for buildings or areas in a central location. Where there is no present control, the three functions can act from a single panel. Where there is inside thermostat control now, add overriding switch panel actuated by outside temperature and a clock.

When the outside temperature drops to within 10 to 15 degrees F of the minimum design level, the heating system might not be able to take care of morning heatup after a night or week-end shutdown. So you need a key-operated switch bypass around the clock for use during prolonged cold periods. This lets you avoid excessive cooling.

Reset the clocks for shorter off-time periods during December, January and February. This increases consumption costs but more than offsets potential

1: Performance unit standards

Utility	Unit	Base for comparison
Process		
Water	Gpm or mgd	Per employe or per unit of production or per sq ft of building area
Air	Cfm	
Gas	Cfm, or units (10,000 Btu)	
Electricity	Kwhr	
Heat	Btu/hr, or lb steam/hr	
Cooling	Tons of refrigeration, 12,000 Btu/hr = 1 ton	
Environmental		
Water	Gpm	Per employe or fixture
Electricity	Kwhr	Per employe or fixture
Heat	Btu/hr or lb steam/hr	Per degree day and building volume
Cooling	Tons of refrigeration	Per cooling degree day or hour

2: Ideal unit consumption—comfort heating

Type of occupancy	Constant K_1
Offices	0.7
Restaurants	3.0
Hotels	1.2
Light manufacturing	0.8
Heavy manufacturing	0.6
Warehousing	0.4

Building size, in cubic feet	Constant K_2
Less than 50,000	1.2
50,000 to 200,000	1.0
200,000 to 500,000	0.9
500,000 to 1,000,000	0.8
1,000,000 to 3,000,000	0.7
Above 3,000,000	0.65

Building construction	Constant K_3
Tight, well insulated	1.0
Normal	1.2
Porous	1.5

Climate, or heating season	Constant K_4
Cold	0.8
Cool	1.0
Warm	1.2

The unit is lb steam per degree day and thousand cu ft of building volume. Target, $lb/DD - MF = K_1K_2K_3K_4$.
Example: 2,000,000 cu ft, light manufacture in cool region:
Target = (0.8) (0.7) (1.2) (1.0) = 0.67 $lb/DD - MF$

psychological difficulties. The same principle applies to ventilating systems during hot summer weather.

Preventive maintenance for the distribution system requires frequent inspections, plus systematic lubrication, testing, service and replacement. Here are some points to check:

(1) Inspect and regrind or replace control-valve seats and disks regularly. This insures positive performance. (2) Inspect steam traps regularly and replace internals at definite intervals, usually yearly, when the loads are light. (3) Keep insulation in good repair for the sake of appearance and economy. (4) Drain or blow pipelines occasionally to remove sediment.

PERSONNEL AND RECORDS

Personnel furnish the direction of utility performance and are the backbone of all economy programs. Management must realize that the engineers responsible for operating generating plants and the maintenance men responsible for operating the distribution system are skilled technicians. They need tools and training to do their assignments well.

Best way to provide the required training is to assign the plant engineer to organize a complete training and education program. This should use the normally generous cooperation of manufacturers' representatives. Also, management should subscribe to trade magazines and insist on their circulation to the lowest operating level.

Management must encourage preventive maintenance, and supply the operators with ample tools and spare parts to follow through. While funds must be controlled, spending in anticipation of need is usually justified.

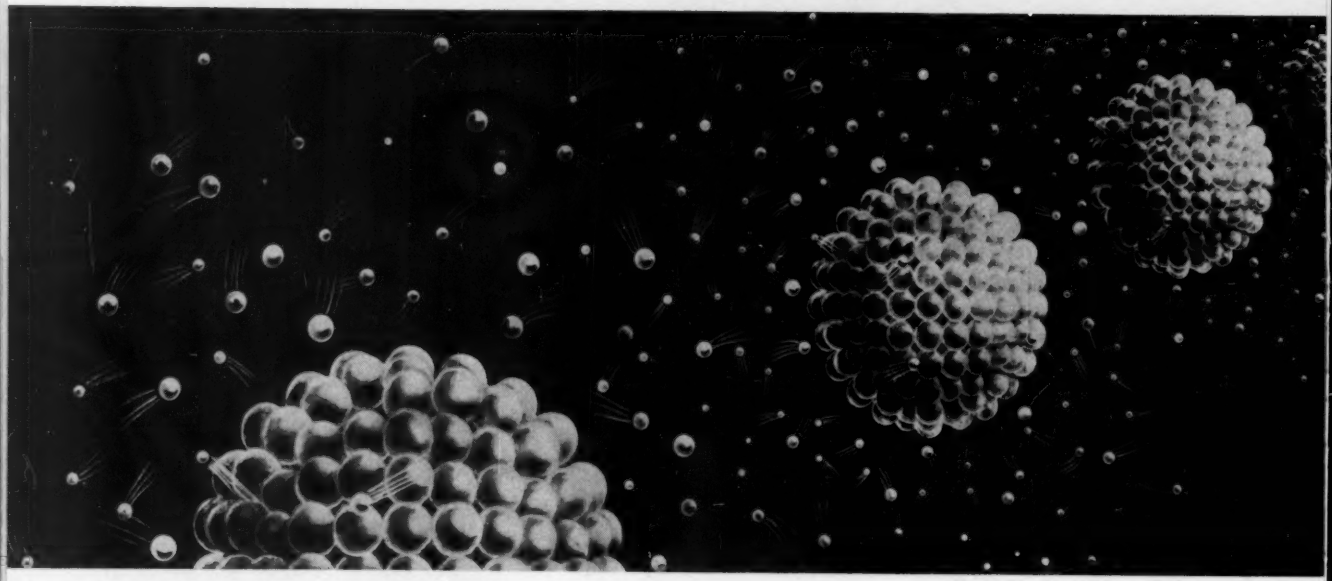
There are many ways of keeping records. Size of the system and its associated cost naturally dictates the time allocated. One man can easily administer records for most facilities, although he may need assistance as the plant size increases. Postings must include at least (1) fuel receipts (2) fuel consumption by day or shift (3) spare parts and labor inventories.

Record fuel receipts on a monthly chart for spot comparisons. This should be used for approximations only, eliminating corrections for weather and building usage. Fig. 2, p 90, shows a typical record of gross fuel deliveries.

Calculate fuel or heat consumption, or both, daily for large plants and weekly for very small plants. Units to use vary with the situation. They can be lb steam or unit of fuel per degree day per thousand cu ft, unit of fuel per process unit, etc. Use the units that describe the actions.

A running daily (or weekly) graph indicates all trends for the operating personnel. Fig. 3 is a typical chart. Forward a monthly composite to management appraising actual past and desired performance.

Spare part and maintenance labor costs should be recorded in gross material and labor form to show true operational maintenance costs. Only trends are important so post figures monthly for study, bottom, Fig. 2.



Trickiest part of a nuclear power plant lies in designing the reactor. A designer must know his materials and their nuclear characteristics thoroughly if he wants to end up with a practical reactor unit. In this final article we . . .

Put together nuclear data to design a reactor

By **HENRY C SCHWENK**, *Henry Pratt Company*
and **ROBERT H SHANNON**, *United Engineers and Constructors, Inc*

► WE TALKED ABOUT the general features and broad design aspects of a nuclear power plant in No. 18, May 1956 POWER. That plant will use a liquid-metal-cooled graphite-moderated thermal reactor. In this final article, we'll complete the design picture and look at investment and operating costs of that plant.

Originally we were thinking of using fuel alloyed with zirconium and clad with this metal. Since then we've decided to switch to natural uranium, U-238 with 0.7% of U-235, clad with stainless steel. This doesn't change any of the data or plans we described in No. 18.

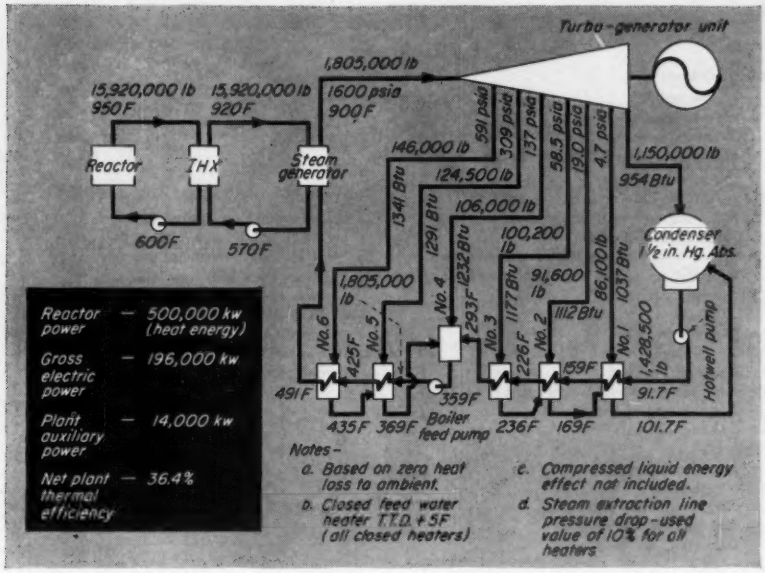
The reactor uses a heterogeneous arrangement of fuel elements and moderator. Pin- or slug-type fuel elements in a graphite matrix form the basis of the design. The reactor having one core only, with no separate breeding section, would be classified as a one-region type.

Reactor design. We will make only rough calculations based on an average neutron-energy level of about 0.025 ev. Complete reactor design must integrate calculations over a range of energy levels—for which we haven't time or space.

We will use a basic approach with which to figure fuel consumed, percentage burn-up, fuel cycle time, etc. To understand reactor design we must recognize that for each material in the reactor there are (1) a given number of atoms per unit volume, the volume being one cubic centimeter, cc (2) a probability of a particular type of nuclear reaction occurring, such as fission capture by U-235, non-fission capture, scattering, etc.

When we speak of atoms per cc we really are interested in the number of nuclei per cc. To figure this we use Avogadro's Constant or Number; this is the number of molecules in one gram-molecular weight or mole. If we're dealing with atoms, Avogadro's Number gives us the actual number of atoms in a gram-atom weight or mole. This is the relation we use for getting nuclei per cc.

Just to jog your memory, a mole is the mass of an element equivalent to the atomic (or molecular) weight expressed in grams. Avogadro's Constant states there are 6.023×10^{23} atoms per gram-atom. We can also say the equivalent: that there are 6.023×10^{23} nuclei per mole.



HEAT BALANCE for 190-mw sodium-cooled graphite-moderated thermal reactor power plant. Steam cycle uses six feedwater heaters. Reactor uses two sodium coolant systems to insure plant safety in case of unforeseen reactor accident. Steam conditions of 1600 psia and 900 F help the plant attain a thermal efficiency of 36.4%

Now let's find the uranium nuclei per cc, N_u. First, we must know that uranium density is 18.68 grams per cc; uranium atomic weight is 238.07, which gives us the equivalent 238.07 grams per mole. Then,

$$N_u = \frac{18.68 \text{ gram}}{\text{cc}} \times \frac{1}{238.07 \text{ gram/mole}} \times 6.023 \times 10^{23} \frac{\text{nuclei}}{\text{mole}}$$
$$= 0.0472 \times 10^{24} \text{ nuclei per cc}$$

We reduce N_u to factors of 10^{24} because the probability cross-section factor is the "barn" expressed in units of 10^{-24}.

Remembering that natural uranium consists of 99.3% of U-238 and 0.7% of U-235 by weight, we then figure their densities as:

$$N_{u\text{-}238} = 0.993 \times 0.0472 \times 10^{24}$$
$$= 0.0469 \times 10^{24} \text{ nuclei per cc}$$
$$N_{u\text{-}235} = 0.007 \times 0.0472 \times 10^{24}$$
$$= 0.00033 \times 10^{24} \text{ nuclei per cc}$$

The density for the moderating material, carbon is:

$$N_c = 1.165 \times \frac{1}{12.01} \times 6.023 \times 10^{23}$$
$$= 0.0825 \times 10^{24} \text{ nuclei per cc}$$

Neutron economy. First neutron economy calculation we base on zero neutron leakage (equal to infinite-sized reactor). Remembering the multiplication factor k represents the average number of fast neutrons produced by each fissioning neutron, we should also recall that k must be greater than one to sustain a chain reaction. The factor for an infinite-size reactor is:

$k' = \epsilon p f \eta$ where

ϵ = fast fission factor that accounts for neutrons from fissioning of U by fast neutrons. For thermal reactors, this factor = 1.03

p = fraction of fast neutrons not absorbed in U-238 while slowing down to thermal level; these are left to produce fission of U-235 at thermal energy level

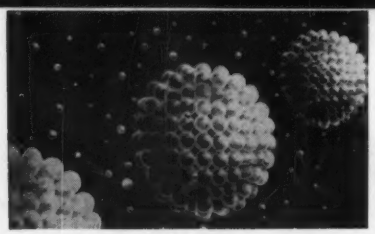
f = fraction of neutrons reaching thermal energy level absorbed in uranium compared to total absorption by uranium, moderator, coolant, cladding, etc. (Turn page)

1: Reactor and coolant system data for 190-mw sodium-cooled graphite-moderated plant

1. Power—rated output (heat)	500 mw
2. Core volume	1360 cu ft
3. Core height	12 ft
4. Core diameter	12 ft
5. Fuel material	Natural uranium
6. Moderator material	Graphite
7. Cladding, internal structure	Stainless steel
8. Coolant fluid	Sodium
9. Volume distribution:	
Fuel	6%
Moderator	80%
Cladding, internal structure	4%
Coolant	10%
10. Critical mass of U-235	305 kg
11. Natural uranium weight	48 t
12. Graphite weight	76 t
13. Coolant temperature, entering core	600 F
14. Coolant temperature, leaving core	950 F
15. Sodium flow:	
primary system	15,920,000 lb/hr
secondary system	15,920,000 lb/hr
16. Sodium temperature: entering boiler	920 F
leaving boiler	570 F

2: Steam and output data for 190-mw sodium-cooled graphite-moderated plant

1. Steam flow (100% load)	1,805,000 lb/hr
2. Steam pressure	1600 psia
3. Steam temperature	900 F
4. Feedwater temperature to boiler	491 F
5. Turbine nameplate rating	190 mw
6. Turbine exhaust pressure	1.5 in. Hg abs
7. Number of feedwater heaters	6
8. Gross generation (100% load)	196 mw
9. Auxiliary power demand	14 mw
10. Net station output	182 mw
11. Net station thermal efficiency	36.4%



NUCLEAR REACTOR
continued

3: Investment for 190-mw sodium-cooled graphite-moderated plant

Reactor Plant:
1. Reactor building
2. Reactor equipment
3. Coolant systems, primary and secondary
4. Auxiliary equipment and facilities

Steam-Electric Plant:
5. Boiler and turbine plant buildings
6. Turbine-generator unit
7. Steam, feedwater, circulating-water systems
8. Electrical equipment, station, transmission switchyards
9. Auxiliary equipment

10. Site improvements

11. Direct cost subtotal
12. Add supervision and indirect cost
13. Add engineering and drafting
14. Add contingencies

15. Add interest during construction
16. Add land cost
17. Add construction taxes
18. Add working capital
19. Estimated total investment

Total plant investment amounting to $55,300,000 is made up of principal investment and system costs plus installation costs and the apportioned costs for indirect items. Amounts depend on location of site and availability of labor, materials and other factors.

η = number of neutrons released by fissioning per neutron absorbed in fuel

As an example, let's see how to calculate the last factor:

$$\eta = \frac{N_{u-235}}{N_{u\text{-}235} \times \sigma_{a-235} + N_{u-238} \times \sigma_{a-238}}$$

where

σ_{f-235} = microscopic fission cross section for U-235
σ_{a-235} = total microscopic absorption cross section for U-235
σ_{a-238} = total microscopic absorption cross section for U-238
γ = total number of neutrons released per fission, an average of 2.5 for U-235

The microscopic cross section of a material is the probability of an interaction with a neutron taking place for each nucleus per unit volume and for each unit of distance traveled by the neutron.

Substituting corresponding values we can solve for:

$$\eta = \frac{0.00033 \times 549 \times 2.5}{0.00033 \times 650 + 0.0472 \times 2.8} = 1.32 \text{ neutrons released}$$

per neutron absorbed in fuel where the cross sections are in barns.

For our reactor: $p = e^{\frac{V_u \Sigma'_u}{V_m \Sigma'_m}}$

where V = volume expressed as a decimal with subscript denoting either uranium or moderator
Σ = macroscopic cross section ($N\sigma$) and the prime denoting resonance range only

Basic value of f may be figured as:

$$f = \frac{V_u \Sigma_u \Phi_u}{V_u \Sigma_u \Phi_u + V_m \Sigma_m \Phi_m}$$

where Φ = neutron flux = $nv = \frac{\text{neutrons}}{\text{cc}} \times \frac{\text{cm}}{\text{sec}}$

Actual value of f must account for effects of: (1) coolant fluid (2) cladding, internal structural material (3) temperature on cross-section data (4) fission products on the neutron economy. In addition, it should also include effect of fuel burnup.

Representative values for our reactor would be:

4: Estimated annual operating costs for 190-mw sodium-cooled graphite-moderated plant

1. Fuel inventory at 4%	$300,000
2. Fuel burn-up	1,000,000
3. Fuel fabrication	700,000
4. Fuel processing, shipping, waste disposal	800,000
5. Operating and maintenance labor	1,000,000
6. Supplies and miscellaneous	300,000
7. Fixed charges at 13%	7,200,000
8. Total annual operating cost	$11,300,000
9. Net output at 80% plant factor	1.274 x 10⁹ kwhr
10. Net energy cost (estimated)	8.9 mills/kwhr

$p = 0.88$ $f = 0.988$ actual $f = 0.895$

Then $k' = 1.03 \times 0.88 \times 0.895 \times 1.32 = 1.07$ for a hot, dirty reactor; where hot means radioactive and dirty means fission product accumulation.

Next we must reduce k' to $k_{effective}$ for our finite-sized reactor; let's call this simply k.

$k = k' S_f S_t$

where S_f = fraction of fast-energy neutrons that do not escape before being thermalized

S_t = fraction of thermal-energy neutrons that do not escape from the reactor core.

$S_f = e^{-K^2 T}$ $S_t = 1/(1 + K^2 L^2)$

where K^2 = "size-shape" factor
T = factor to account for distance (or time) a neutron travels from the moment it is released by fission to the moment it becomes thermalized. For our reactor $T = 120$ cm
L = thermal diffusion length, measures distance (time) from the point when neutron has become thermalized until it is captured for fission or absorption

For a right-circular cylinder:

$$K^2 = \left(\frac{2.405}{R}\right)^2 + \left(\frac{\pi}{H}\right)^2$$

where R is cylinder radius and H is cylinder height. For an R of 6 ft or 182.5 cm and H of 12 ft or 365 cm we get a $K^2 = 2.47 \times 10^{-4}$

Heterogeneous arrangement of the reactor affects the thermal diffusion-length factor:

L^2 (actual) $= L^2\ (1-f)$ (actual f) (V_r/V_m)

where L = thermal diffusion length in moderator

f = thermal utilization factor

For our reactor $L = 100$ cm and $V_r/V_m = 1.25$, then L^2 (actual) $= 100^2\ (1-0.988)\ (0.884/0.988)\ 1.25 = 135$ sq cm Combining these factors we can now figure effective k:

$$k = \frac{1.07\ e^{-247\times10^{-4}\times120}}{1 + 2.47 \times 10^{-4} \times 135} = 1.003$$

This shows that the reactor is slightly above critical, even in the hot and dirty condition. It will be controllable, however, and can sustain a chain-fission reaction with allowance for temperature effect, fission-product poisoning effect and fuel burn-up effect on reactivity.

Fuel consumption. Now let's study the amount of fissionable material used:

Fission rate, fissions per sec $= P_T \times C$

where P_T = total reactor power, watts = 500 mw

C = fissions per watt-sec $= 3 \times 10^{10}$

Substituting: Fission rate $= 500 \times 10^6 \times 3 \times 10^{10}$

$= 1.5 \times 10^{19}$ fissions per sec

The core dimensions are R of 6 ft and H of 12 ft, making a volume of 1360 cu ft. The fuel, natural uranium, occupies 6% of this volume or 81.5 cu ft, which equals 2.32×10^6 cc.

Now, Total $N_{u-235} = 0.007\ N_u V_f$

where V_f = total volume of fuel, U-235 and U-238. Then

Total $N_{u-235} = 0.007 \times 0.0472 \times 10^{24} \times 2.32 \times 10^6$

$= 7.67 \times 10^{26}$ U-235 nuclei in the reactor

Since there are 1.5×10^{19} fissions per sec for the U-235 and 6.023×10^{23} nuclei per mole for U-235 and 235 grams per mole, we can figure fissionable material consumed as:

$$\text{U-235 burned} = \frac{1.5 \times 10^{19}}{6.023 \times 10^{23}} \times 235 = 5.84 \times 10^{-3} \text{ grams/sec}$$

Then for 8760 hr per year and a plant factor of 0.8 the fissionable material consumed for power only:

$= 5.84 \times 10^{-3} \times 3600 \times 8760 \times 0.8 = 147$ kg per year

The U-235 is consumed by fissioning for power and also lost by absorption. This proportion is expressed by:

$$\alpha = \frac{\text{U-235 (total capture cross-section)}}{\text{U-235 (fission cross-section)}} = 1.2$$

Taking this into account, the total U-235 consumed per year is $147 \times 1.2 = 176.5$ kg per year.

The average fuel cycle (fuel-element assembly life) depends on the maximum allowable percent burn-up of nuclei in the reactor and the fission rate.

Reserve your copy now

McGraw-Hill Book Company will publish this nuclear-energy study course as a book. It will be on sale by early 1957.

Allowable percent burn-up

$$= \frac{\text{total allowable atoms fissioned in fuel}}{\text{total number of atoms in fuel}}$$

We regard both U-235 and U-238 as the fuel. The allowable percent burn-up depends on the total integrated radiation dosage and radiation energy level and the effect on fuel material dimensional stability, thermal conductivity and other characteristics. For our reactor we will peg maximum allowable burn-up at 0.2%.

Maximum allowable atom burn-up

= (% burn-up) (fuel atoms/cc) (total cc fuel)

Substituting

$= 0.002 \times 0.047 \times 10^{24} \times 2.32 \times 10^6 = 2.18 \times 10^{26}$

Next, let's figure:

$$\text{Average fuel cycle time} = \frac{\text{Allowable fuel atom burn-up}}{\text{Fission atom burn-up/sec}}$$

$$= \frac{2.18 \times 10^{26}}{1.5 \times 10^{19}} = 1.45 \times 10^7 \text{ sec} = 4{,}040\text{hr} = 30 \text{ weeks (approx)}$$

We'll now figure the reactor neutron flux:

$\Phi_{avg} = (P_T \times C)/\Sigma f \times V_f)$

$\Sigma f = N_{u-235} \times \sigma_{f-235}$

$= 0.00033 \times 10^{24} \times 549 \times 10^{-24} = 0.181$

Substituting

$\Phi_{avg} = (500 \times 10^6 \times 3 \times 10^{10})/(0.181 \times 2.32 \times 10^6) = 3.57 \times 10^{13}$

The term *neutron flux* means "rate of flow" of neutrons; it's figured as the product of neutron density (neutrons/cc) and neutron velocity (neutron energy in cm/sec). Neutron flux in a reactor is not uniform. The neutrons "pile up" in the center of the reactor and they leak out through its surface. The ratio of maximum to average flux might be about 1.5. Heat-generation distribution in the reactor core duplicates the neutron flux distribution.

Reactor control. We talked about reactivity in Part 9, April 1955. Reactivity of a reactor changes as the temperature varies between cold shutdown and hot operating condition. The designer must find the effect of temperature changes on the reactivity of a reactor. He does this by studying the temperature effect on nuclear properties and material densities of the fuel, moderator and coolant.

Variation in neutron leakage from the reactor with temperature change and other factors must also be considered.

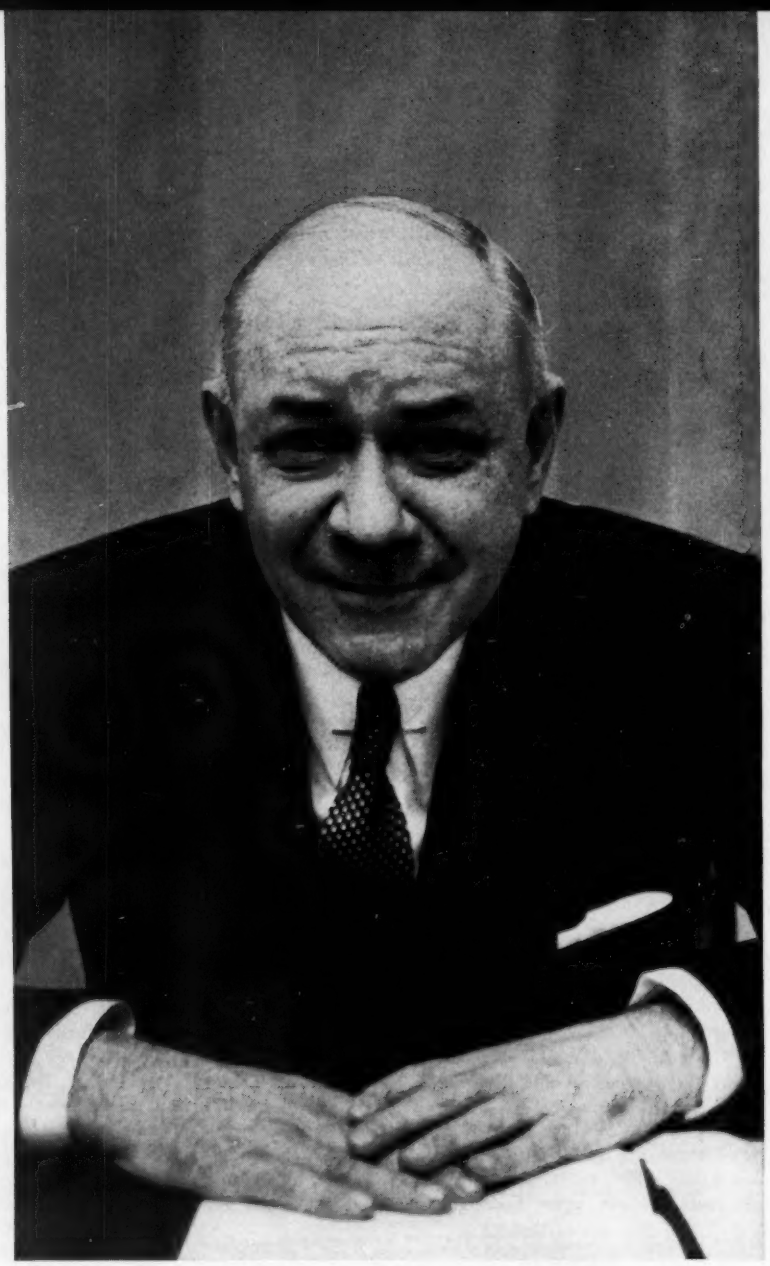
Longtime effects also change reactivity—for example, fuel burn-up and fission product accumulation. These may all be regarded as negative reactivity changes. The net effect of these requires an excess of fissionable material in the reactor to have a reasonably long operating run before refueling is needed.

To compensate for the extra fissionable material we must have an equivalent amount of negative reactivity in the control rods. As the extra fissionable material disappears with burn-up, the control rods must be withdrawn further to reduce neutron absorption and maintain chain reaction.

Steam plant. Diagram on p 93 shows the plant heat balance and output data. Heat losses have been assumed as zero; actually they would be less than ½%. Table 2 lists the principal specifications for the plant. Plant auxiliaries will need a total of 14 mw at full load. These include: (1) primary-coolant system pumps (2) secondary-coolant system pumps (3) boiler feed pumps (4) condenser auxiliaries (5) reactor building cooling systems (6) inert-gas systems (7) control and instrumentation systems.

The 500-mw reactor develops a net electrical output of 182 mw at a thermal efficiency of 36.4%.

(*Continued on page* 206)



Plant lube budget is mighty small stacked alongside cost of production equipment, labor, raw materials. Often spending more for lubrication leads to trimming those big-cost items. So L T White of Cities Service outlines . . .

Tips on selling a better lube plan

► YOU MAY BE CONVINCED that better plant lubrication will trim down-time, step up production, increase company profits. But you still have the job of selling the idea topside at budget time. Your real starting point is pinning down just what you mean by better lubrication for your plant. Too many plant engineers, according to L T White of Cities Service Petroleum, are simply absorbing the gospel of fewer types of lubricants and attendant economies of purchasing. Sure, where waste or other evidence of poor engineering is present, trimming the sails is a logical step. But the real criterion is overall plant costs since lubrication directly affects the latter through longer machine life, smoother production. In many plants, according to White, the smartest approach for maximum company benefit is to *triple* the company's present investment in industrial lubrication.

In a talk before the New York Section of the American Society of Lubrication Engineers, White outlined some of the basic thinking he felt is needed to logically raise lubrication from an item in the list of mill supplies to a function of top management. Although his talk was primarily pegged for the oil-company lube engineer. similar thinking may well hold for the plant engineer and his top lube man.

Once you've maneuvered through the engineering, pointing up the need for spending more money on plant lubrication, your big job is convincing your boss that it's a smart move for general plant operation. The approach then—and this is the heart of White's remarks—is basically the same for selling any idea topside: first study management, then reach

The lubrication engineer: Key to smoother, lower-cost operation

Years back, machine operators were often skilled mechanics who lubricated and maintained their own units. They may not have been lubrication experts, but they did have a single-minded interest in keeping them going.

New ways. As industry became larger and more specialized, maintenance tended to separate from operation. And, unfortunately, lubrication too often drifted off into an independent chore that got little real attention from anybody. "Oiling" became a low-skill low-pay job with little incentive. Today, lubrication engineers, relative newcomers to the professional field, are stepping into the picture.

Organizing. Best way to tackle the job of modernizing lubrication practice in your plant is to think of it as a separate function in the maintenance set-up —not as an odd job done in spare time. Approach varies, depending on whether the lube group is being set up in a new plant or an existing one.

Start early. In a new plant, the lubrication engineer in charge should work closely with designers, keeping them on the beam as to operation and maintenance. In this way, most-effective lubrication equipment can be installed at the start and the whole system co-ordinated for best working results. To maintain this good start, staff the lubrication group with trained men.

In an existing plant, you move step by step, but goal is the same—efficient, economical lubrication.

Typical approach in a really big plant was outlined by John Boal of U.S. Steel Corp in a talk before the ASLE some time back. Boal points out the success of any plant-wide lubrication program depends upon close co-operation among certain key individuals and groups within the plant's organizational structure. Who these people are, titlewise, varies, depending on the company. You'll run into a variety of setups: Typical for big plants includes the plant lubrication engineer, lubrication groups in each operating unit, equipment operators (who sometimes, for isolated machines, hold responsibility for lubricating their own machines) lubricants storekeeper.

Another approach to plant lubrication in a large organization is found in American Can Company. Of course, American Can is big by any of today's standards for sizing organizations. They have 61 manufacturing plants and five machine-shop centers.

Back in 1948, this company employed their first lubricating engineer, Roy K Tonning. Two years later, a well-equipped laboratory was set up in their Newark, N.J. technical center to handle the many tests associated with modern big-plant lubrication.

What he does. What can you expect from a lubrication engineer on your staff? Well, let's set up Tonning as an example. Top management looks upon him as a wear-reduction engineer. He serves in an advisory capacity to each of the company plants in solving specific lubrication problems. Tonning concerns himself with the technical side of lubricant purchasing (the company purchasing agent does the actual buying) and the application of those lubricants to plant machinery.

Above outline centers around lubrication thinking in a large-plant organization. Smaller plants might hesitate, and rightly so, to consider a full-time lube engineer. What to do?

First step in sprucing up your present lubrication program is to call in your oil supplier and get the benefit of his experience. Today, all leading oil companies have the facilities to survey your plant and offer you the basis for a modern lubrication program. It's yours for the asking.

Once you've got the best thinking of the oil company's lubrication engineers, consider membership in the growing American Society of Lubrication Engineers for you or one on your staff. To get more information about ASLE write W P Youngclaus, Administrative Secretary, American Society of Lubrication Engineers, 84 E. Randolph St, Chicago 1.

management, next change management. And it's a big task.

Fundamental job of your head man boils down to (1) provide better service for users of products you are involved in making, (2) increase profits, (3) pay bigger dividends to plant owners, (4) increase wages all around. Sure, the top-kick takes your say-so on specific types of lubrication equipment, lubricants to buy, but you have to prove your point in any major upward revision of the lube budget.

Plant-lubrication practice is a reflection on management. Case in point, brought out during White's talk, involved a company that was running into trouble because of sloppy billing and attendant correspondence. This was so even in the face of expanded manufacturing facilities and outlets. By poking his nose into office mechanical problems the lube engineer came across the real cause: Office machines were being fouled up by sugar getting to the innards from coffee and soft drinks. The point: influence of the lubrication engineer can be felt today in many areas apart from the straight production machines: a strong factor in attempting to upgrade any lube program.

Many specific approaches are available to help you sell a better lube program. In one plant the lube engineer plotted materials, labor, equipment depreciation and lubrication costs in bar-chart form. The dollar figure for lube and its application was mighty small stacked up against the majors. His point was the big-money bars (materials, labor, equipment) are trimmed through better plant lube. But he, and you if you try a similar approach, must prove that point.

1 X-ray examination of partially completed butt weld in 17 5/16-in.-OD, 3-in.-thick, 2¼%-chromium, 1%-molybdenum alloy-steel pipe for high temperatures, pressures

Welding chrome-moly alloy-steel piping

Higher steam pressures and temperatures pose new problems in pipe welding, design and materials. Here is a major review of the work done to improve welded power piping in recent years

By I H CARLSON and E J HEMZY
Crane Co

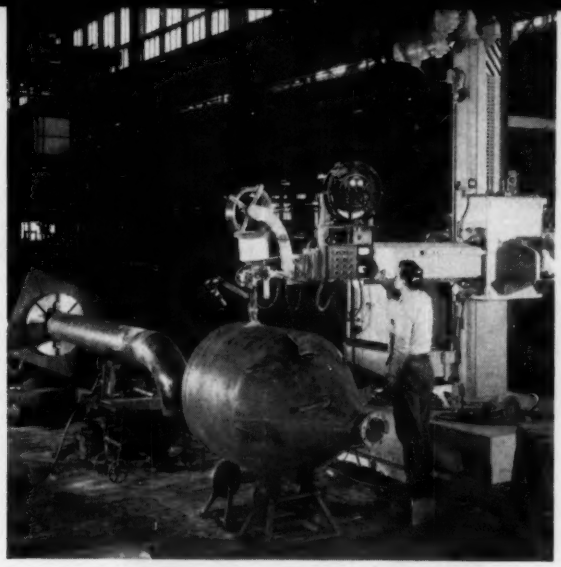
► WELDING of steam-power piping got its real start when operating temperatures reached and exceeded 850 F and carbon-molybdenum alloy steel was introduced. Since that time, the application of welding has progressed to the point where today it is used exclusively for all high-temperature high-pressure piping. Before the temperature (above 750 F) necessitated the choice of alloy steels, carbon-steel material was used, generally with mechanical joints throughout the system. However, oxyacetylene welding was being employed in a number of applications.

In recent years, carbon molybdenum in the steam power industry has been restricted to temperatures below 850 F, as a result of graphitizaton that occurs in the weld contact zone above 900 F, after prolonged service. First evidence of this phenomenon became known in 1943, when a brittle failure occurred at a welded joint of carbon moly in a pipeline in Springdale Station, Pa. As a result of investigation throughout the industry to determine the cause of this failure, it was found that the addition of chromium, a strong carbide former, tends to stabilize the structure and inhibit the formation of graphite.

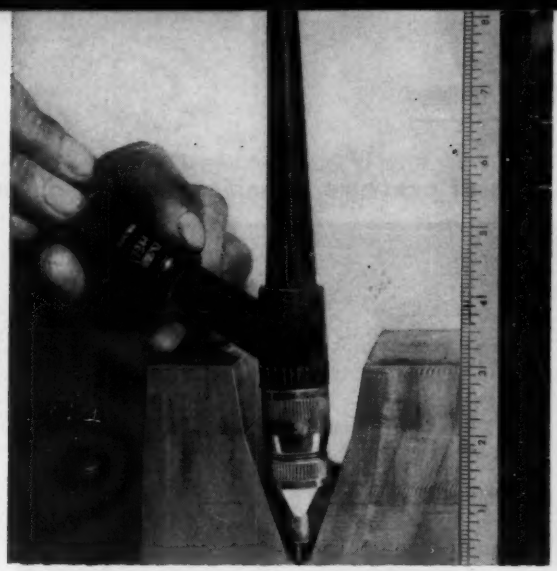
Piping materials for service at elevated temperatures and pressures must remain stable over extended periods of time, be normally resistant to corrosion and erosion, with high-temperature oxidation resistance and adequate resistance to plastic flow (creep and stress rupture). Good welding properties are of utmost importance. Further, the material should be such that it can be fabricated satisfactorily by bending, forming and similar operations. Thus, the use of chromium-molybdenum alloys was brought about. As Table 1 shows, several nominal compositions are employed. Temperature ranges for these and other materials are listed in Table 2, p 101.

Over 1050 F, the trend has been to use austenitic chromium-nickel stainless-steel alloys—particularly Type 347. Recent surveys show that the great majority of units being planned or built are in the range of 900 to 1050 F, where the low chromium-molybdenum alloy steels are employed.

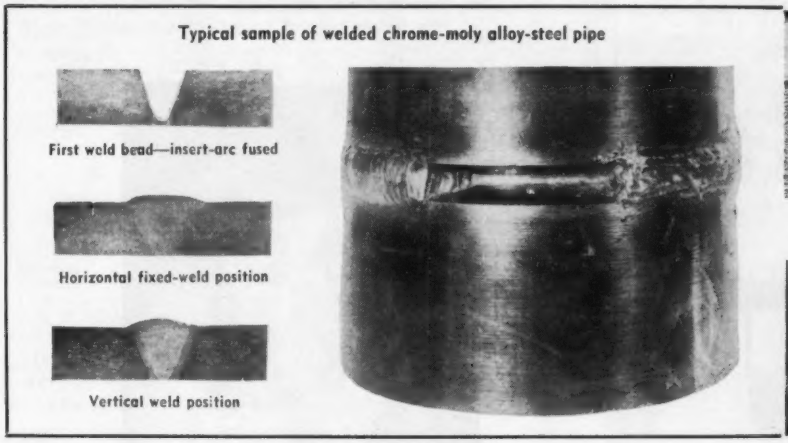
For fabricating this series of alloys, considerable research and development have been carried out to establish satisfactory welding procedures and techniques. Experience thus far indicates these materials are stable and will continue to give trouble-free performance. For austenitic alloys, continued studies are necessary to more fully understand problems associated with their fabrication. For these reasons only welding



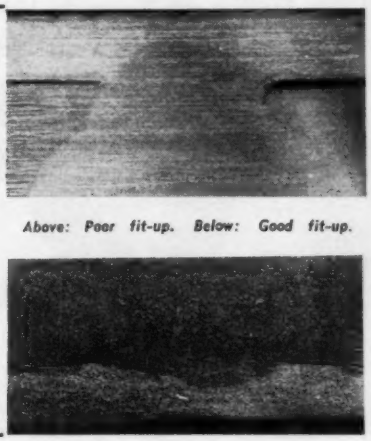
2 Automatic submerged-arc-welding equipment in pipe fabrication shop has many uses in power-piping manufacture



3 Inert-arc welding of first pass in 3-in.-thick material using standard torch for this type welding of power pipe


Typical sample of welded chrome-moly alloy-steel pipe
First weld bead—insert-arc fused
Horizontal fixed-weld position
Vertical weld position

4 Appearance of sample showing inert-arc fused root and completed metal-arc welds in various positions on a 10-in.-dia, 1-in. thick, 2¼%-Cr, 1%-Mo pipe



5 Root cracking in the poor fit-up of backing ring and ferritic base metal

of chromium-molybdenum piping is considered here.

Lab investigations. Early in 1946, with the advent of chrome moly, it became necessary to conduct numerous lab investigations for the Crane Co to establish welding procedures. Also, the necessary operator and procedure qualification tests were conducted, and suitable sources of filler metal determined. The latter became an important phase of the work since supply sources were either unavailable or extremely limited. Often it required cooperation of electrode manufacturers to develop suitable electrodes.

As a result of these studies, suitable manual metal-arc procedures were developed and, more recently, procedures for inert-arc first-pass techniques to obtain smooth root contour. This eliminates the need for a backing ring. In addition, the submerged-arc process has been fully investigated and suitable procedures developed. All these techniques and procedures are being employed satisfactorily in shop fabrication today.

When welding studies were originated, the manual metal-arc process with coated electrodes was the only means of welding chromium-molybdenum alloys. Alloyed bare wire only recently became available so the submerged-arc process could be fully investigated and evaluated.

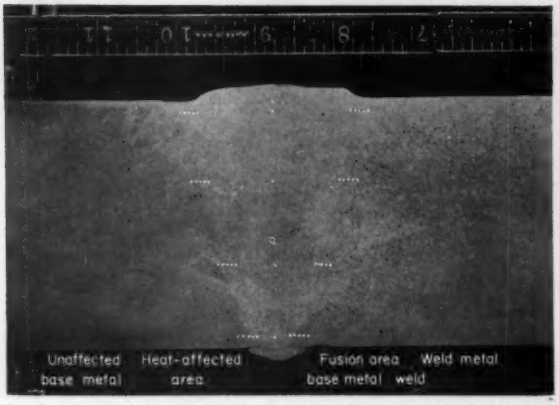
Selecting the filler metal in welded joints required consideration of the chemistry of deposit, usability characteristics and mechanical and physical properties of the electrode. The electrode was always selected so the weld-metal composition closely matched that of the base metal. It was important that the weld and base metals have similar strength and other necessary mechanical and physical properties at elevated temperatures.

Most electrode manufacturers accomplished this by adding alloying elements to the electrode coating. Before initiating procedure weld tests, the chemistry of the weld deposit for electrodes used was determined from the third layer of standard 5-layer build-up pads. Table 3 shows typical analyses of the alloy types investigated. Note the core wire was always a mild-steel composition with the alloying elements chromium and molybdenum introduced by the coating.

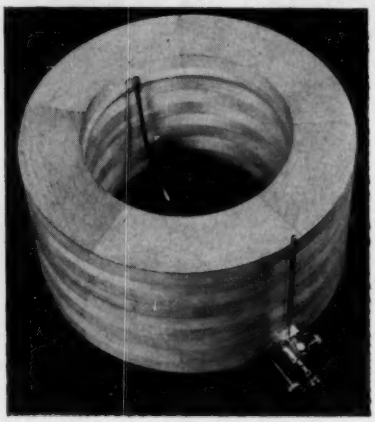
After sources of electrodes with suitable chemistry were established, electrode suitability tests were conducted. However, consideration had first to be given to preheat, post-weld heat treatment and joint design.

The need for preheat and postheat treatments was considered because most

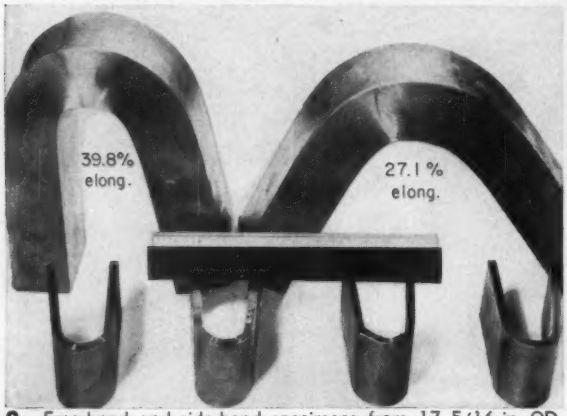
Limits of pressure classification and dimensional standards are being exceeded



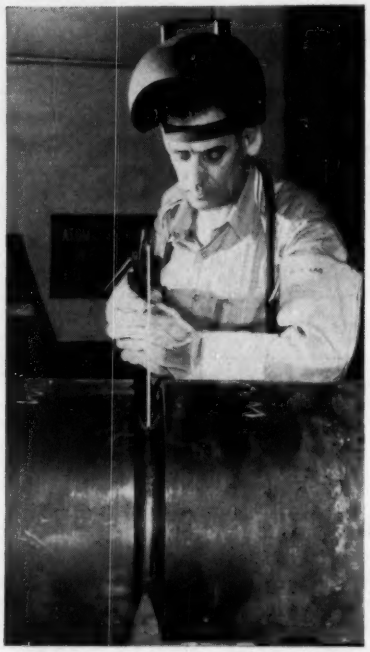
6 Section of butt weld in 2¼%-Cr, 1%-Mo alloy-steel stress-relieved pipe showing the Vickers' hardness survey



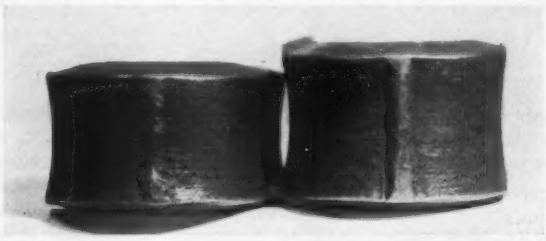
7 Device for placing radium capsule in the survey hole of heavy-wall piping



8 Free-bend and side-bend specimens from 17 5/16-in.-OD, 3-in.-thick, 2¼%-Cr, 1%-Mo alloy-steel cast power piping



10 Welding setup for chrome-moly alloy steel pipe, showing groove



9 Comparison of inert-gas purged weld under side, *left*, and specimen of same material made without purging, *right*

of the chromium-molybdenum steels are air-hardening to a degree depending on the chromium and carbon content of the steel. To determine more easily the post-weld heat treatment, dilatometer studies were made to establish the lower critical transformation points of the various alloys. From these studies, a temperature was selected to assure that the lower critical would not be exceeded in the normal limits of production equipment.

The lower critical or transformation temperature for 2¼% Cr, 1% Mo alloy-weld deposit was about 1472 F, and from these data an upper limit of 1375 F (or approximately 100 F below critical) was established for it. The air-cooled specimen exhibited a lowering of critical temperature on cooling over the slow-cooled specimen. This results in a suppressed transformation.

As a result, it was determined that preheating the base material would be desirable to eliminate the possibility of cracking due to combined stress levels of welding and volume changes occurring during transformation. It was reasoned that preheat would slow down the rate of cooling and bring

1: Chromium-moly alloy steels for high-temperature high-pressure steam piping — ASTM Specification A-335

Material		Main elements			Strength	
Nominal Composition	Grade	C	Cr	Mo	Tensile psi	Yield psi
½ Cr, ½ Mo	P 2	0.10-0.20	0.50-0.81	0.45-0.66	55,000	30,000
1 Cr, ½ Mo*	P 12	0.15 max	0.81-1.25	0.45-0.66	60,000	30,000
1¼ Cr, ½ Mo**	P 11	0.15 max	1.00-1.50	0.45-0.66	60,000	30,000
2 Cr, ½ Mo	P 3b	0.15 max	1.65-2.35	0.45-0.66	60,000	30,000
2¼ Cr, 1 Mo	P 22	0.15 max	1.90-2.60	0.87-1.13	60,000	30,000

*Si 0.50 max **Si 0.50 to 1.00

2: Temperature ranges of piping steels generally utilized in central-power stations

Material		Temperature range, F
Nominal composition	ASTM specification	
Carbon steel	A-53 or A-106, Grade A or B	Up to 750
Carbon moly	A-335, Grade P 1	Up to 850
½ Cr, ½ Mo	A-335, Grade P 2	750-950
1 Cr, ½ Mo	A-335, Grade P 12	850-1000
1¼ Cr, ½ Mo	A-335, Grade P 11	850-1045
2 Cr, ½ Mo	A-335, Grade P 3b	Not being used to any extent
2¼ Cr, 1 Mo	A-335, Grade P 22	1000-1060
18 Cr, 8 Ni, Cb	A-312, TP-347	Above 1050

3: Typical electrode-deposit and core-wire analysis for chromium-moly alloys

Alloy	Description	Chemistry						
		Si	Mn	S	P	C	Cr	Mo
½ Cr, ½ Mo	Deposit	.10	.30	.026	.021	.06	.57	.40
	Core wire	.01	.49	.017	.020	.07	.03	.03
1 Cr, ½ Mo	Deposit	.30	.56	.029	.022	.06	1.05	.45
1¼ Cr, ½ Mo	Core wire	.01	.40	.025	.012	.08	.02	.01
2 Cr, ½ Mo	Deposit	.20	.39	.022	.018	.07	2.34	.48
	Core wire	.02	.41	.024	.017	.08	.03	.03
2¼ Cr, 1 Mo	Deposit	.35	.62	.029	.024	.10	2.24	.96
	Core wire	.01	.59	.032	.014	.11	.05	.02

4: Preheat, interpass temperature control and post-weld heat treatment for chromium-moly alloy steel piping

Material		Temperature, F		
Nominal composition	Grade*	Preheat	Interpass	Post-weld**
½ Cr, ½ Mo	P-2	400 Min	400 Min	1250-1300
1 Cr, ½ Mo 1¼ Cr, ½ Mo	P-12 P-11	400 Min	400 Min	1275-1325
2 Cr, ½ Mo	P-3	400 Min	400 Min	1300-1350
2¼ Cr, 1 Mo	P-22	500 Min	500 Min	1300-1375

*All alloys are in ASTM Specification A-335.
**Two hours per inch of pipe-wall thickness but not less than ½ hour.

5: Typical room-temperature mechanical properties of all-weld-metal deposits*

Nominal composition	Base material**	AWS-ASTM electrode class.	Tensile strength psi	Yield strength psi	Elongation % in 2 in.
½ Cr, ½ Mo	P-2	E-7010	66,500	53,000	25.0
		E-7015	77,500	62,500	29.5
1-1¼ Cr, ½ Mo	P-11, P-12	E-8010	71,500	54,400	27.0
		E-8015	78,300	62,500	28.0
		E-8016	86,700	75,600	22.5
2 Cr, ½ Mo	P-3	E-8010	82,500	61,000	21.0
		E-8013	96,500	82,000	12.0
		E-8015	99,000	83,000	23.0
2¼ Cr, 1 Mo	P-22	E-9013	95,000	79,500	17.5
		E-9016	91,200	72,000	27.5

*As determined from standard 0.505-in.-dia specimens. Heat treated in accordance with Table 4.
**ASTM Specification A-335.

6: Typical results of mechanical tests on horizontal fixed-position pipe welds; stress-relieved 2 hr

Electrode mfr, AWS-ASTM classification	Reduced sec tensile Ultimate, psi*	Free-bend test		Jig-bend test		
		Elong, %	Degree bend, deg	Side bend	Root bend	Rating
A, E-8010	71,100	10.7	129	1 failure of 4	OK	NG
	71,400	19.7	Bent dbl			
B, E-8010	70,900	35.4	Bent dbl	OK	OK	OK
	70,100	34.2	Bent dbl			
C, E-8015	69,500	28.4	120	OK	OK	NG
	69,600	27.2	105			
D, E-8015	76,500	37.0	Bent dbl	OK	OK	OK
	72,200	31.6	Bent dbl			
E, E-8015	67,100	30.8	Bent dbl	OK	OK	OK
	69,400	30.6	Bent dbl			

*Failure occurred in base metal in all cases.

7: Typical performance data for 1¼-chromium ½-moly alloy steel — AWS-ASTM Class E-8016 electrode

Test specimen	Position	Deposition rate lb/hr	Deposition efficiency %	Welding speed ft/hr	No. of weld passes
10-in. Schedule-160 pipe (approx 1-in.-thick wall)	Flat (down hand)	3.79	64.04	17.5	10
	Overhead, vertical flat	2.22	58.3	9.20	6

8: Undiluted weld-metal chemistry and room-temperature mechanical properties — standard tensile specimens

Alloy	Si	Mn	S	P	C	Cr	Mo
1¼ Cr, ½ Mo	.32	.57	.022	.010	.06	1.02	0.63
2¼ Cr, 1 Mo	.65	.87	.015	.020	.05	2.14	0.90

Alloy	Tensile, psi	Yield, psi	% elong 2 in.	Red. area, %
1¼ Cr	74,500	67,000	27.5	57.5
2¼ Cr	84,500	64,000	28.0	62.0

about transformation at higher temperature levels where the material could better absorb these changes.

Hardness. Besides the dilatometer studies, the effect of heat treatment on hardness levels in the weld and base-metal heat-affected zones was investigated. It was shown that the effect of exceeding the lower critical, 1472 F, was a hardening effect.

The need for post-weld heat treatment was indicated by bend results on 1% Cr, ½% Mo alloy material. Failure occurred in the as-welded specimen and satisfactory results were obtained for heat-treated specimens. Table 4 is a summary of the preheat interpass temperature control and post-weld heat treatment established by studies in our welding laboratory for welding procedures of various alloys for the pipe.

Details of joint design received considerable attention. Standard end preparation for groove welds in pipe in accordance with the 1952 ASA *Code for Pressure Piping B31.1*, was found suitable for pipe-wall thicknesses up to about 1¾-in. However, with use of pipe-wall thicknesses much beyond this to accommodate the higher pressures

Pipe welding got its real start in 850-F plants

and temperatures, it became necessary to consider a modification of the groove design.

In this study it was recognized that the groove should require only the minimum amount of weld metal and provide good accessibility to enable satisfactory welding at the root passes. This work resulted in the Crane Co developing and adopting a special design.

Fig. 10 shows a test setup to investigate the welding of 3¾-in.-thick 17 5/16-in.-OD pipe and use of this special welding groove. Recently, the industry adopted a similar design (ASA —B16.5).

Metal backing rings are widely used in butt-welded joints of piping structures which are inaccessible for grinding or welding of the underside of the joint. Backing rings primarily prevent weld drippings, spatter and flux slag from entering the pipe. They are designed to provide solid metal against which the weld metal of the first bead is deposited. Although many types of backing rings are manufactured for pipe fabrication, the most commonly used are flat rings rolled from strip material for ordinary application, and machined rings for critical service, such as main steam piping.

The inside of pipe ends are bored for the machined rings for a snug fit. The machining dimension is calculated so it will not encroach upon the minimum required pipe-wall thickness.

The most troublesome of the problems met with metal backing rings is the necessity for accurate fitting of the ring with ID of the pipe being joined. Accurate fit-up is required to prevent the possible formation of weld-metal cracks. These originate at the notch or separation between the backing ring and the inside surface of the pipe on poor fit-up joints. Fig. 5 shows an example of root cracking, which can occur with poor fit-up of backing and ferritic base metal.

Problems inherent with metal backing rings have led to developing inert-gas shielded tungsten-arc (TIG) welding techniques of the first pass in the piping field. Highlights of this work are covered later in this article.

In conducting electrode suitability tests, a plate test was first made using 1-in.-thick plate in the down-hand position of welding, employing groove design, preheat interpass temperature control, electrode diameters, and post-heat treatment, which were to be used in actual procedure qualification tests. During welding, the arc characteristics, arc stability, weld soundness, slag removal, bead appearance and general performance were noted.

On completing the welding and post-weld heat treatment, the specimen was subjected to radiographic examination. Standard 0.505-in.-diameter tensile bars were machined from all-weld deposit coupons removed from the plate joint. Typical results from alloys investigated are shown in Table 5. These results were used to ascertain the room-temperature mechanical properties to be expected of filler-metal deposits in an actual completed joint. Note from results in Table 5 that the lime-coated (AWS-ASTM Class E-8015) electrode possesses desirable mechanical properties for 1¼% chromium, ½% molybdenum alloy welds. This type electrode gave a higher ultimate tensile strength, coupled with good ductility.

After completing the plate tests, those electrodes that were satisfactory were further evaluated by conducting performance tests on pipe. These tests were primarily conducted to observe the usability characteristics of the electrodes.

For these tests, either seamless pipe or cast tubular sections, in pipe sizes from 8 to 12 in., and wall thicknesses ⅝ to 1 in., were manually metal-arc-welded together. During these tests, arc characteristics, arc time, deposit efficiency, deposition rate, ease of slag removal, soundness of weld beads and bead appearance were observed and the entire weld inspected by radiography. Typical performance data, Table 6, show comparative results with 1¼% chromium, ½% moly alloy in the down-hand and horizontal fixed positions of pipe welding using AWS-ASTM Class E-8016 electrodes.

Test specimens were removed from the pipe weld for mechanical tests. These consisted of all required for procedure qualification by the ASA and ASME *Code*, Section IX, plus additional specimens for hardness surveys, metallographic studies and mechanical tests designed to evaluate soundness of filler metal and welding technique and procedure. These tests served not only to check the suitability of various types of electrodes and sources but also to qualify the welding procedure at the same time for the thickness and position employed. Typical results during this type of study are shown in Table 7.

At the time that 2¼% chromium, 1% moly alloy came into use for steam-power piping it was felt that the procedure qualification test should be conducted on pipe whose actual wall thickness was equal to that to be fabricated on a job. The reason: It was desirable to evaluate to the fullest extent any problems that could be encountered in producing a sound weld joint. A special weld study was, therefore, conducted on 3 5/16-in.-thick 17-in.-OD tubular sections to evaluate methods of preheat and stress relieving, welding technique and procedure. Specimens were removed for mechanical testing in accordance with ASA and ASME *Codes* for procedure qualification.

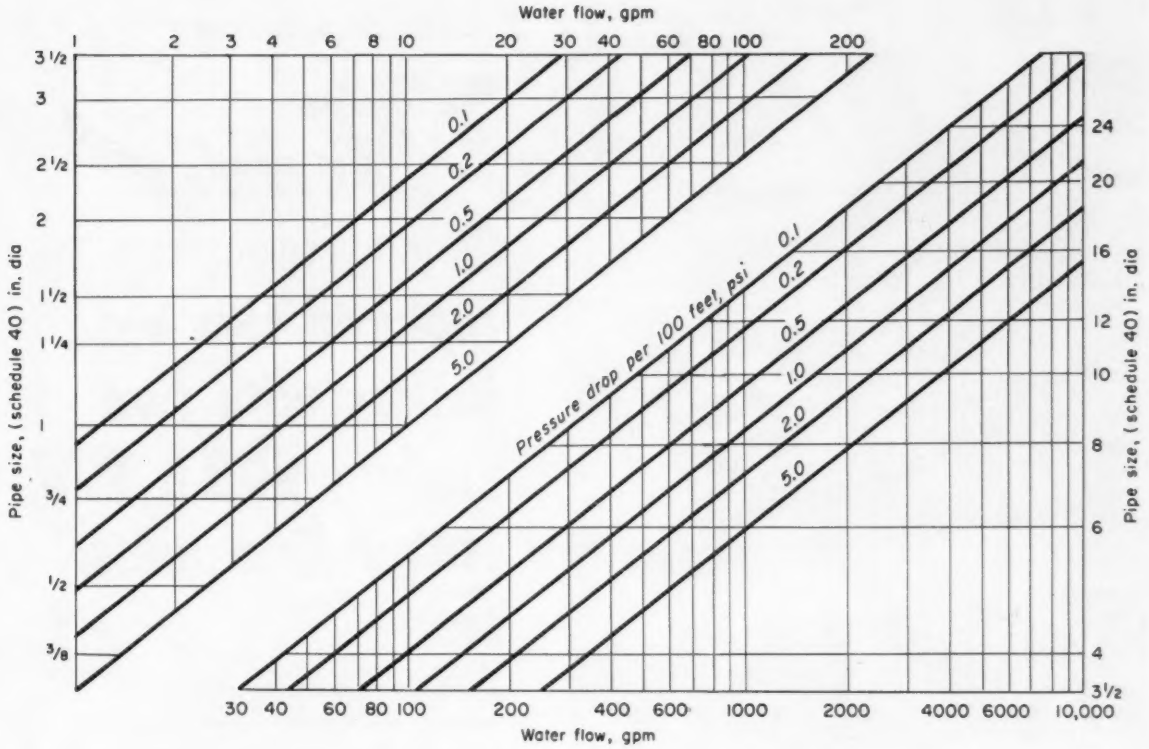
Fig. 6 shows a cross section of this weld, which is representative of many weld joints in today's steam power plants. Fig. 1 and 10 show the radiographic and test setup with welding performed in the horizontal fixed position of the pipe. Fig. 8 shows bend-test results of specimens removed from the completed weld after heat treatment. Note the major failure, which occurred in one free-bend specimen, is in the base material adjacent to the weld joint. Since forged and bored pipe, to be used in the dimensions required, was not available for the test, tubular sections were cast material.

After finishing the welding studies, the complete procedure qualification required by ASA and ASME *Code for Pressure Piping* was carried out. It employed the technique and procedure established during the initial studies. This consisted mainly of (1) making the welds in the positions that were to be used in our shop production and (2) conducting the mechanical tests specified by the *Codes*. In addition, radiographic studies were carried out to more fully evaluate the soundness of technique and procedure. As the *Code* requires, records are maintained of the qualification-test results and, in addition, the qualification-test specimens are preserved for reference.

Inert-arc, first-pass technique. Thus far, we have been primarily concerned with the metal-arc process and coated electrodes. However, there has recently been increasing interest in eliminating backing rings from high-pressure high-temperature steam-pipe systems. Toward this end have come a number of new developments. Most of them center around the inert-gas shielded tungsten-arc (inert-arc) process as applied to the first weld pass. Our laboratory has carried out much work to develop a suitable procedure with this technique.

Inert-arc welded joints can be made by various methods using either butted pipe or slight root openings, and with or without filler metal. Remainder of

(*Continued on page* 194)



Choosing pipe sizes for water systems

► WHEN SETTING UP piping systems for water, we have to know two main factors: (1) how much water must be delivered (2) how great a pressure drop can be allowed to point of delivery. The Williams and Hazen formula has been widely used to figure pressure drops:

$$f = 0.2083(100/C)^{1.85}\, q^{1.85}/d^{4.8655}$$

where

f = pressure drop in ft of liquid per 100 ft of pipe

d = pipe inside diameter, in.

q = liquid flow, gpm

C = constant depending on surface roughness

Chart above has been based on this formula, assuming $C = 100$. Instead of ft of liquid the pressure drop is given as psi.

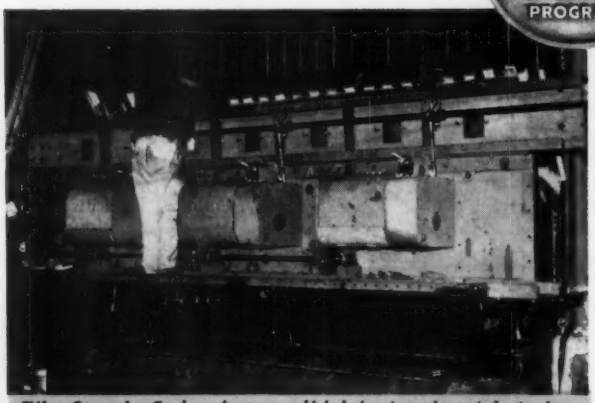
Example: Find the size of pipe needed to deliver 600 gpm if no more than 0.5 psi per 100 ft pressure drop may be allowed. First locate 600 gpm on the horizontal axis, read up to intersect the 0.5 pressure-drop curve and read on the right-hand scale: 8-in. Schedule 40.

W M ELLER *Kekaha, Hawaii*

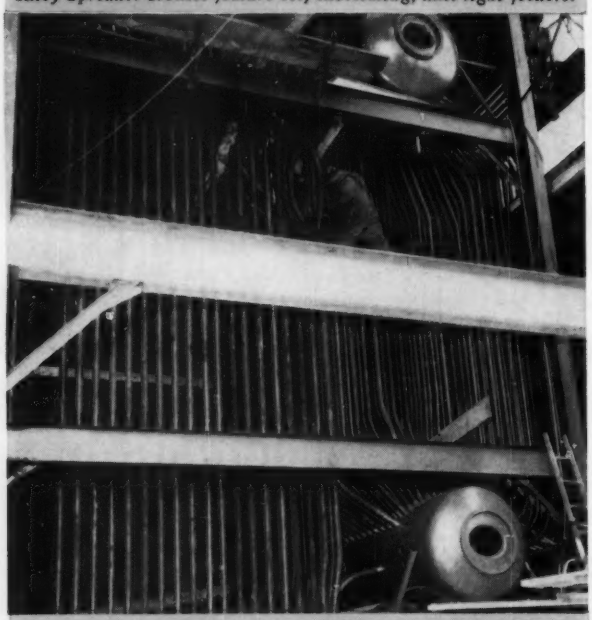
© POWER

Power MODERNIZATION PROGRAM

another POWER MODERNIZATION CITATION WINNER . .



Riley Spreader Stokers feature self lubricating, dust-tight feeders.



Care is given to tube spacing and alignment in Riley units.

at its Bendix Products Division
South Bend, Indiana

Bendix
AVIATION CORPORATION

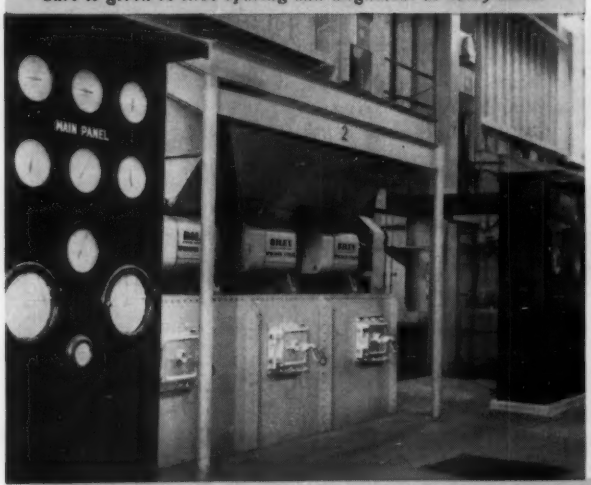
replaced two old boilers with two modern RILEY stoker fired units to:

cut fuel costs 19% per 1000 lbs. of steam

boost efficiency from 70% to 82%

lower maintenance costs 80%

up availability from 50% to 96%



Two views of the Bendix firing aisle show Riley Traveling Grate Hydraulic Drives and overhead coal conveyor system.

. and another example of why it pays to modernize . . . and with RILEY BOILERS and RILEY FUEL BURNING EQUIPMENT

SINCE installing two 80,000 lb/hr. Spreader Stoker fired Riley units, savings to Bendix Products Division at South Bend, Indiana in coal consumption have amounted to many thousands of dollars per year, enough to pay for the modernization within a comparatively short time. This added to savings in production due to increased availability, and savings resulting from an 80% decrease in cost of maintenance means still shorter write-off time of investment . . . and with Riley equipment an assurance of many years of dependable, low cost operation.

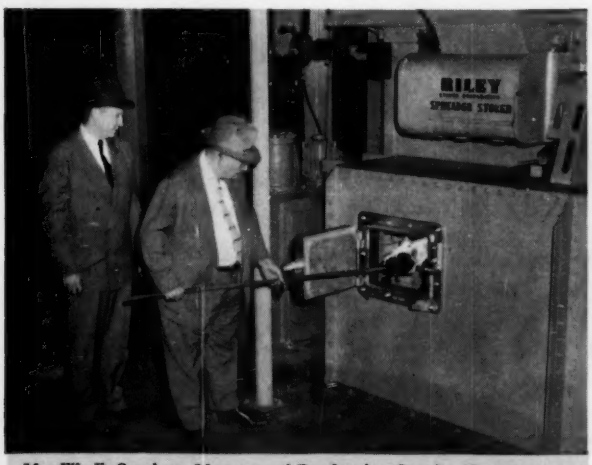
Nature of the Bendix Modernization Program

- Replace two 511 H.P. Boilers with two 80,000 lb/hr. Riley Units fired by Riley Traveling Grate Spreader Stokers.
- Revamp building to accommodate boilers and coal handling equipment.
- Install 500 ton overhead bunker and coal elevator-conveyor system.
- Increase capacity of water softener, filter, boiler feedpumps and air system.
- Install new steam headers, coal unloading shelter and ash washer.

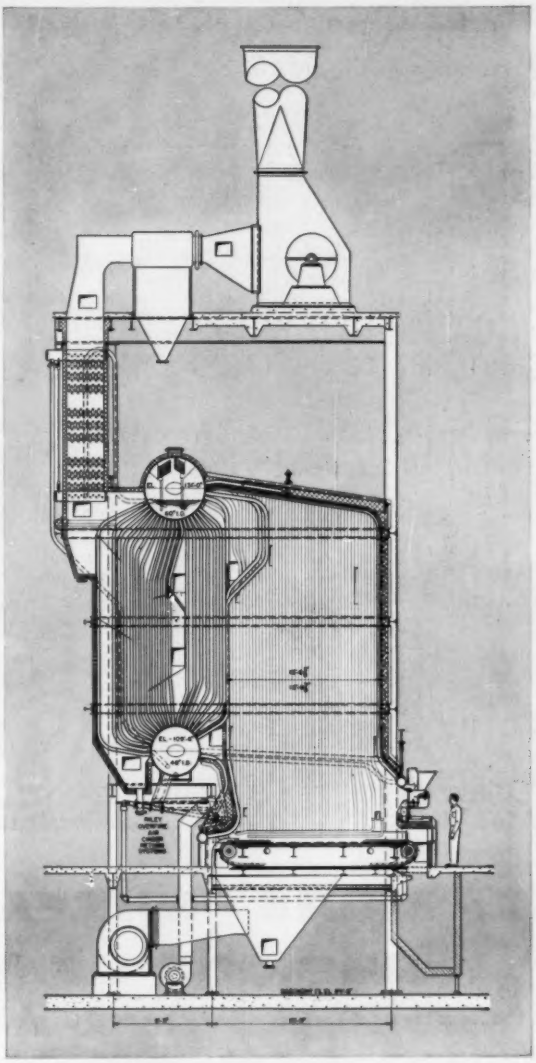
Problems Solved to Maintain Operation During Modernization

- Demolish tall brick stack.
- Support of roof of building while removing building columns.
- Excavate and form new footings under walls for coal bunker.
- Pour new foundations for boilers

Bendix is to be congratulated for its 1955 POWER MODERNIZATION AWARD winning program. Of the twelve winners in this contest Riley equipment was featured by five companies: Bendix, Pennsylvania Railroad, Garlock Packing Co., Carbide and Carbon Chemicals Co., and The Flintkote Company.



Mr. W. E. Sanders, Manager of Production Service Departments, lights off with Paul E. Rudbeck, Power Plant Superintendent.



Two Riley Traveling Grate Spreader Stoker Fired Units, capacity 80,000 lbs/hr; 160 psig design, saturated; Riley Continuous Tube Economizer.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

RILEY
Stoker Corporation
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

4 MORE "BUFFALO" FANS DELIVER 688,000 CFM POWER PUNCH

at Encina Station of San Diego Gas & Electric Co., Carlsbad, Calif.

FORCED AND INDUCED DRAFT

The two "Buffalo" Double Width Fans on the left deliver up to 137,500 cfm combustion air. On the right are two "Buffalo" I.D. Fans (capacity, 206,500 cfm) discharging the boiler gases to the chimney.

Call on "Buffalo" know-how and equipment for satisfaction in any mechanical draft problem you may have. Your nearby "Buffalo" Engineering Representative is ready and qualified to help you.

Write for full details today!

"Buffalo"

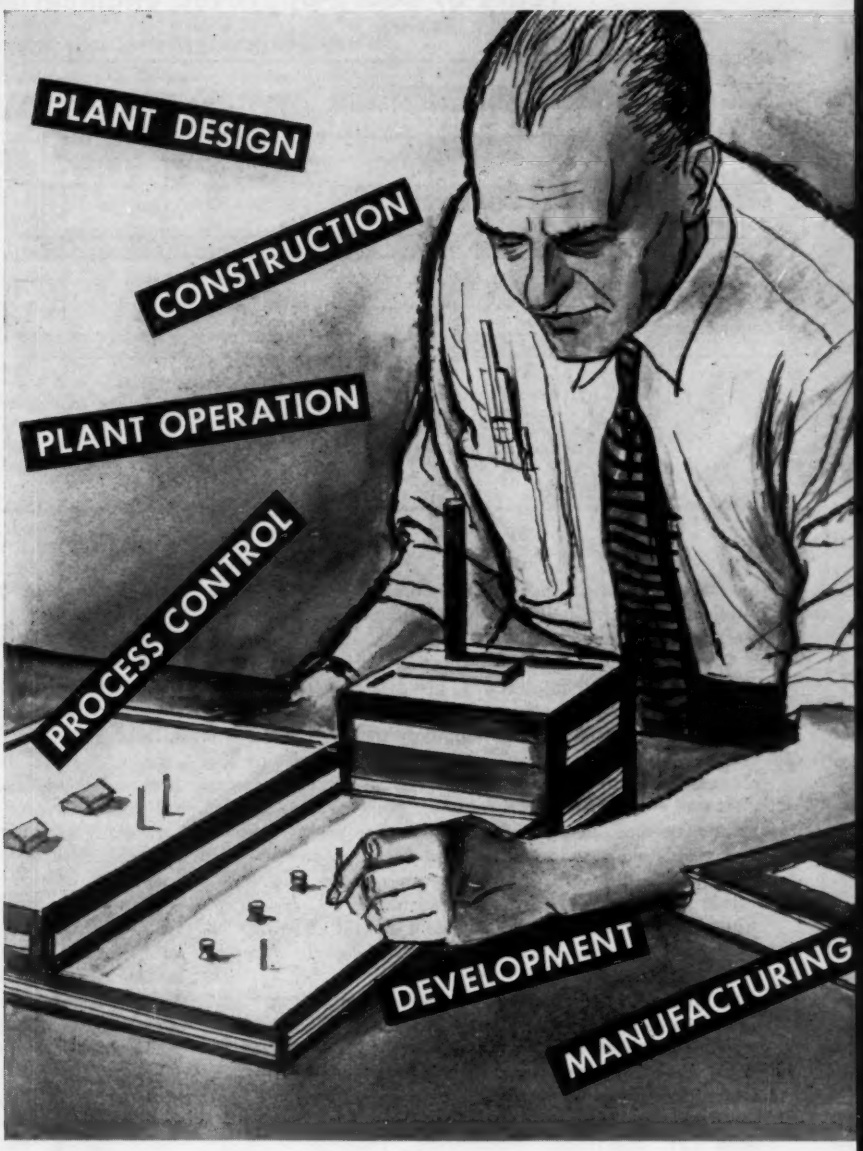
BUFFALO FORGE COMPANY

BUFFALO, NEW YORK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

STEVE ELONKA
Associate Editor in Charge



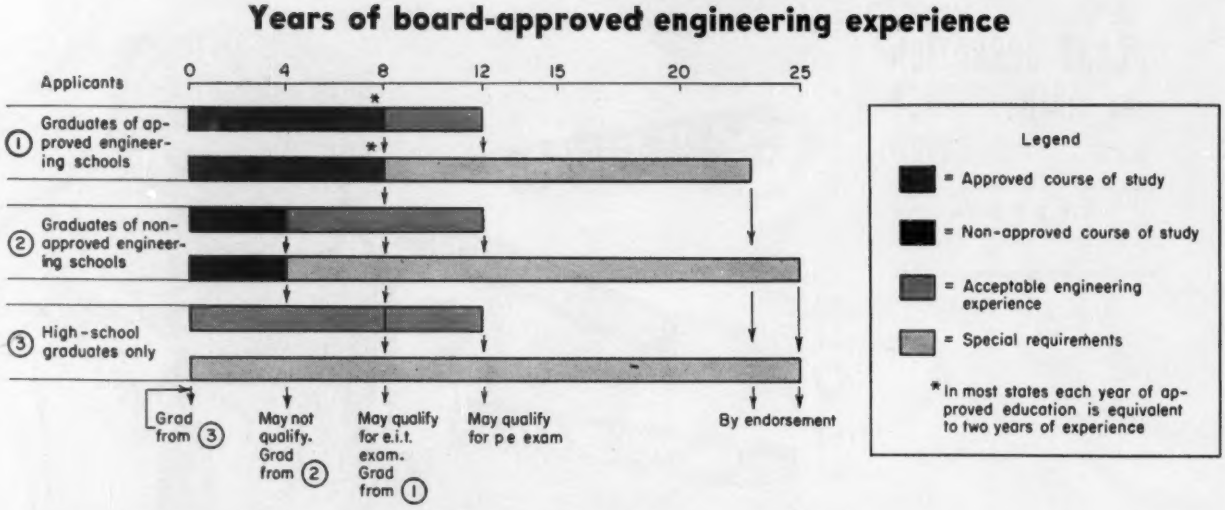
Mr Power-Service Engineer...

Should you get your PE license?

By **JOHN CONSTANCE,** *Professional Engineer*

► ALL 48 STATES, the District of Columbia and our territorial possessions have registration laws regulating the practice of engineering. Legal registration of the professional engineer (PE) is aimed at protecting the public. And the public must be the first consideration of every engineer.

Scope. Many of those persons concerned with licensing now favor registration of both the principals and all engineering employes of firms engaged in work of an engineering nature where health, life, safety and social well-being of the general public are involved. And today almost any design,



operation or process undertaken by the engineer has public implications—from buildings, power plants and bridges to electric motors and appliances.

Courts agree that the design of power and heating plants, water systems, buildings, sewage-disposal plants, etc, justifies the registration requirements for those in responsible charge. State registration permits only those engineers who can safely serve the public to practice, and denies this responsibility to those found incompetent by examination.

Power engineers, plant engineers, plant superintendents, maintenance engineers, and men in similar positions are in responsible charge of men or work. Their positions require professional licensure if they are to protect the public within the meaning of their state registration act. By *responsible charge* is meant the independent control and direction, by use of initiative, skill and judgment, of complete projects in an engineering field.

As an example, the responsibility of the above men might, and often does, fall into one or more of the following categories: (1) responsible design, supervision and construction of power plants, heating, ventilating and air-conditioning systems, refrigeration, internal-combustion engines and power-plant equipment (2) development of plants and processes (3) appraisals, investigations, research, economic studies, cost analyses and reports (4) operation of major power-plant and mechanical and electrical installations, manufacturing plants and application of instruments and controls to manufacturing processes (5) editing and writing on engineering subjects, and (6) full-time teaching in accredited engineering schools.

Chart, above, gives a quick picture of how you fit into the qualification picture for the professional engineering license. The requirements for registration, which vary from one state to another, are difficult to summarize. But all states fit into the above chart rather well. Most states require all candidates to pass a written examination, except those men with long-established practices, and of an age close to 50 years.

Engineering experience submitted by all candidates for licenses must be of a character and grade satisfactory to the board of examiners. Remember, the number of calendar years of experience you have may not necessarily equal the number of years of *approved* experience the board recognizes. Acceptable approved experience is something defying exact definition. But all boards insist that approved experience be broad in scope and of such a nature as to have developed and matured the applicant's knowledge and judgment. To learn the requirements of your particular state, contact the examiners at the address given in the table, p 109.

Lack of a college degree is not a handicap to securing a professional engineering license. See how this works in the chart above. While it is generally true that an applicant for professional registration should have at least a Bachelor of Science degree in his chosen field of engineering, there are many examples where this is not true. Were this rule in use today, the profession would stand to lose the services of many outstanding engineers who are making history.

Examiners recognize that the ability of an engineer to solve ordinary engineering problems depends on his skillful use of handbooks, charts and the specialized knowledge of authorities, combined with a liberal sprinkling of common sense. Relatively little higher mathematics is involved in day-by-day practice of engineering.

Licensure by endorsement. Because the boards recognize that some engineers have not attended college, but are still making outstanding contributions, applicants with long experience and of mature age (50 or over) are given special consideration. The examiners usually grant interviews, possibly with short oral or written examinations to test the basic knowledge of engineering practices possessed by these candidates. A part, or parts, of the regular written examination is waived. But before a board will approve an applicant for licensure by endorsement, it will always endeavor to make certain that he is fully qualified. Boards recognize that years of outstanding experience and achievement are far better evidence of qualifications than are the results of written examinations.

Factors helping an applicant obtain a license by endorsement include technical papers, advanced studies and degrees, technical society membership and activities, patents, respect of fellow engineers and important developments in his chosen field of activity. In some states a man must show at least 15 years of approved engineering experience *after* graduation from an accredited school of engineering. Nongraduates may also be considered, but in their case the qualifications are even more rigorously applied, in addition to an interview to determine engineering knowledge and achievement.

Steps to register are simple, being about the same in

Where to write for info on the professional license

If you live in . . .	Write to your *State Registration Board* at . . .
Alabama	Clifton C Cobb, Executive Secretary, 711 High St, Montgomery 5
Alaska	Leo H Saarela, Secretary, Box 854, Anchorage
Arizona	Rayma Neeb, Room 302, 128 N 1st Ave, Phoenix
Arkansas	V E Scott, Secretary, Box 175, Pulaski Hts Station, Little Rock
California	J D Locke, Executive Secretary, 529 Business & Professional Building, Sacramento 14
Colorado	J H Bailey, Asst Secretary, 20 Capitol Bldg, Denver
Connecticut	W K Simpson, Secretary, 30 Oak St, Hartford 6
Delaware	F T Lynch, Secretary, 311 W 12th St, Wilmington
Dist of Columbia	Mrs L W Coad, Asst Secretary, 1740 Massachusetts Ave, NW, Washington 6
Florida	Mrs A P Clover, Executive Secretary, 408 John F Seagle Bldg, Gainesville
Georgia	C L Clifton, Joint Secretary, 111 State Capitol, Atlanta
Hawaii	W C Furer, Asst Secretary, 1909 Also Place, Honolulu 14
Idaho	O C Mayer, Secretary, 623½ Main St, Boise
Illinois	F B Selcke, Supt of Registration, State Capitol, Springfield
Indiana	Ferdinand Jehle, Secretary, 230 State House, Indianapolis
Iowa	W G Cunningham, Secretary, State Capitol Bldg, Des Moines 19
Kansas	Mrs Della Serrett, Executive Secretary, 422 Garlinghouse Bldg, Topeka
Kentucky	C S Crouse, Secretary, c/o Univ of Kentucky, Lexington
Louisiana	F W MacDonald, Executive Secretary, Rm 233 Civil Engrg Bldg, Tulane Univ, New Orleans 18
Maine	B L Hopkins, Secretary, Box 103, Waterville
Maryland	J W Gore, Secretary, 1101 Key Highway, Baltimore 30
Massachusetts	Mrs. G J Cammon, Secretary, Room 34, State House, Boston
Michigan	H G Groehn, Executive Secretary, 1604 Cadillac Sq Bldg, Detroit 26
Minnesota	H D Carlson, Executive Secretary, 316 New York Bldg, St. Paul
Mississippi	O B Curtis Sr, Secretary, PO Box 3, Jackson
Missouri	Mrs C V Wall, Secretary, Box 184, Jefferson City
Montana	E R Dodge, Secretary, c/o Civil Engrg Dept, Montana State College, Bozeman
Nebraska	R M Green, Secretary, 210 Ferguson Hall, Univ of Neb, Lincoln
Nevada	S G Palmer, Secretary, c/o College of Engrg, Univ of Nevada, Reno
New Hampshire	W E Haynes, Secretary, c/o Secretary of State, State House, Concord
New Jersey	T E Heathcote, Secretary, 921 Bergen Ave, Jersey City
New Mexico	S E Reynolds, Secretary, PO Box 1079, Santa Fe
New York	N L Freeman, Secretary, 23 S Pearl St, Albany 7
North Carolina	R B Rice, Secretary, PO Box 5131, N. Carolina State College, Raleigh
North Dakota	A L Bavone, Secretary, Box 1265, Minot
Ohio	R N Waid, Secretary, 21 W Broad St, Columbus 15
Oklahoma	G B Hill, Secretary, 2901 Classen Blvd, Oklahoma City 6
Oregon	E A Buckhorn, 717 Board of Trade Bldg, Portland 4
Pennsylvania	Miss R J Nickles, Secretary, 324 Education Bldg, Harrisburg
Puerto Rico	J Mercado-Cruz, Secretary-Treasurer, PO Box 3271, San Juan
Rhode Island	P S Mancini, Secretary, 246 State Office Bldg, Providence
South Carolina	T K Legare, Secretary, PO Drawer 1404, Columbia
South Dakota	E D Drake, Secretary, c/o S. Dakota School of Mines & Tech, Rapid City
Tennessee	Granbery, Jackson Jr, Secretary, 503 Nashville Trust Bldg, Nashville 3
Texas	C L Svensen, Executive Secretary, 308 W 15th St, Austin 3
Utah	F E Lees, Director, 324 State Capitol Bldg, Salt Lake City
Vermont	W D Emerson, Secretary, c/o Norwich Univ, Northfield
Virginia	T N Burton, Secretary, PO Box 1-X, Richmond
Washington	E C Dohm, Secretary, Dept of Licenses, Professional Div, Transportation Bldg, Olympia
West Virginia	Robert Williamson Jr, Secretary, 301 Morrison Bldg, Charleston
Wisconsin	W A Piper, Secretary, 1140 State Office Bldg, Madison 2
Wyoming	Mrs W H Land, Asst Secretary, 207 State Capitol Bldg, Cheyenne

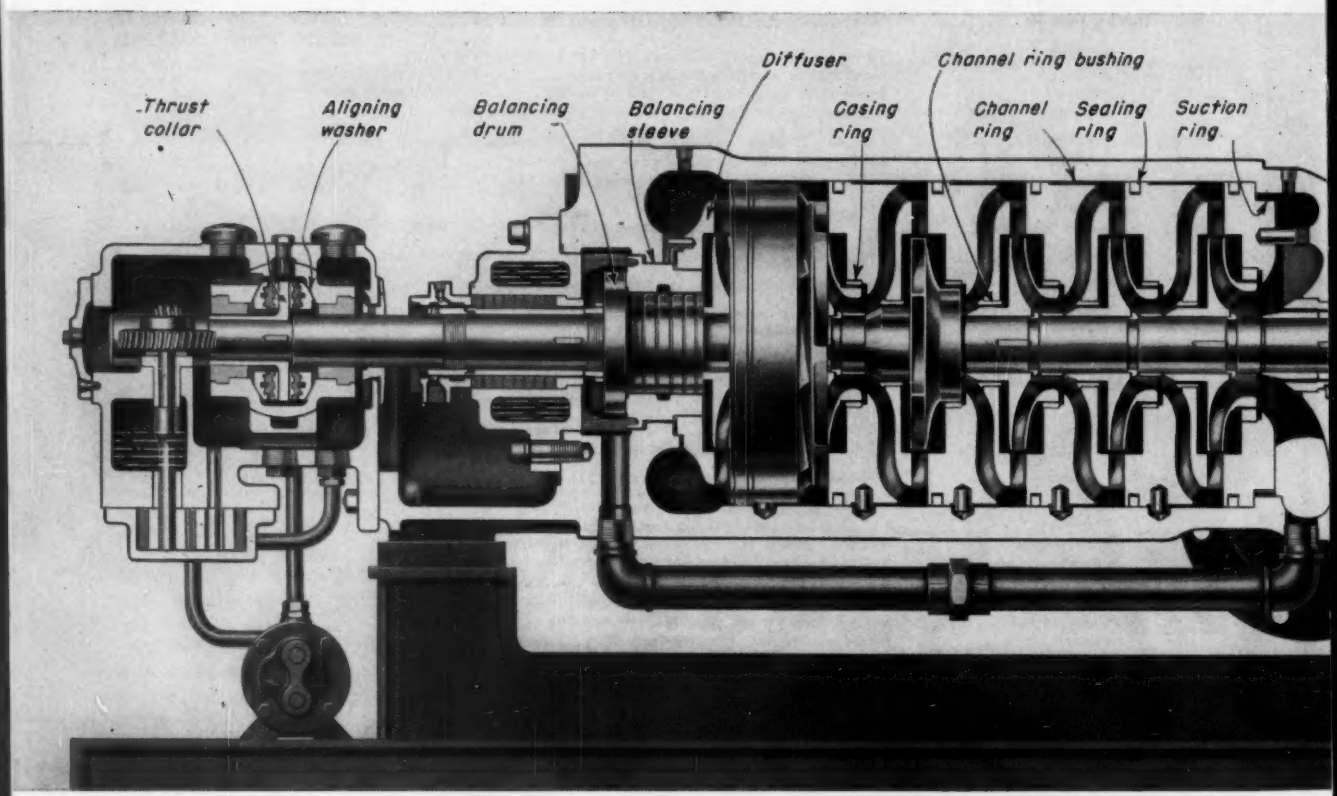
every state. They are: (1) Write to the person listed in the table above, requesting a copy of the state registration act and a copy of the application form. (2) Fill out the form, provide the necessary references and return the form to the state office, along with the registration fee.

Experience record, entered on application, is extremely important, especially for engineers with long records. Many applicants do not seem to understand how to give full weight to their hard-earned record. As a result, this vital information is not too well documented.

Remember, when evaluating an applicant's record, the board members must reach their decision on the basis of the data in the application. They cannot read between the lines, nor can they go by hearsay. So describe your experience in detail—mere listing of job titles is not enough. Give enough info so the board gets a rounded picture of your engineering work. Most boards look for a progression to important duties, reflecting a growth in professional judgment.

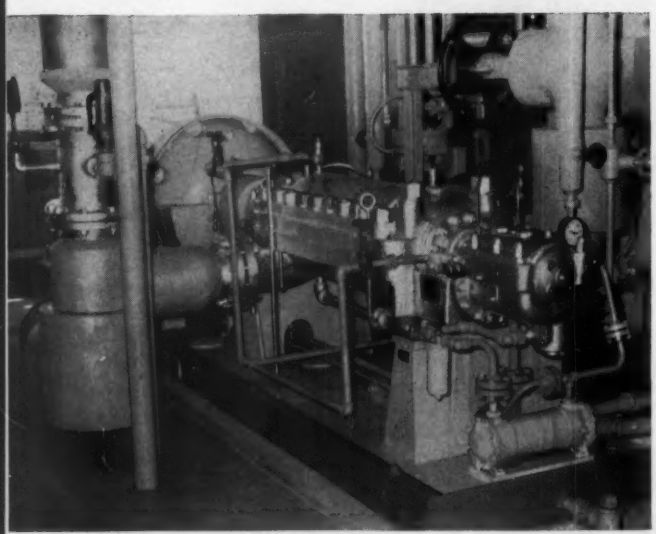
Refresher courses, home-study courses and a number of books are now available to help a candidate prepare for the professional license examination. Use any one or more of these aids, if necessary. They will help you pass the exam.

Getting your professional license may be the biggest step in your career. So proceed carefully, give the board full knowledge of your qualifications and bone up for the exam. *Watch future issues for another article on getting your PE.*



By STEVE ELONKA *Associate Editor*

Let's check and repair a split-

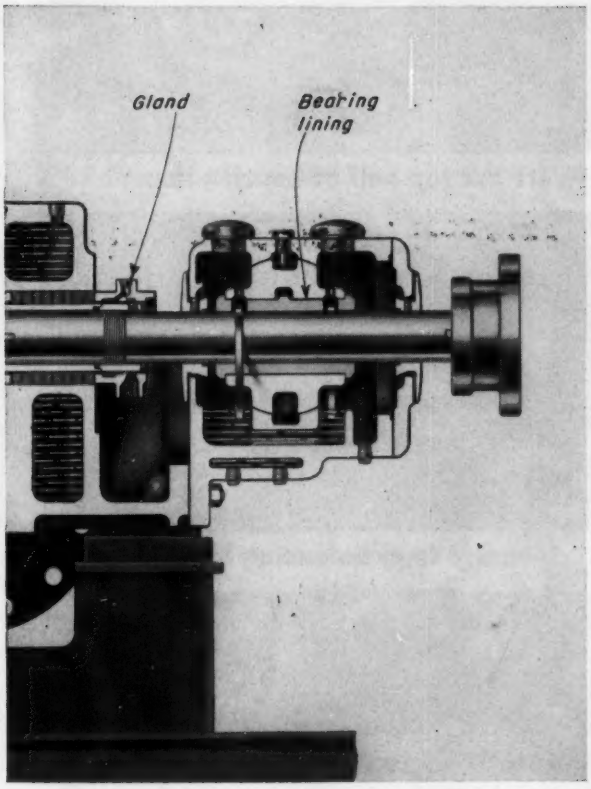


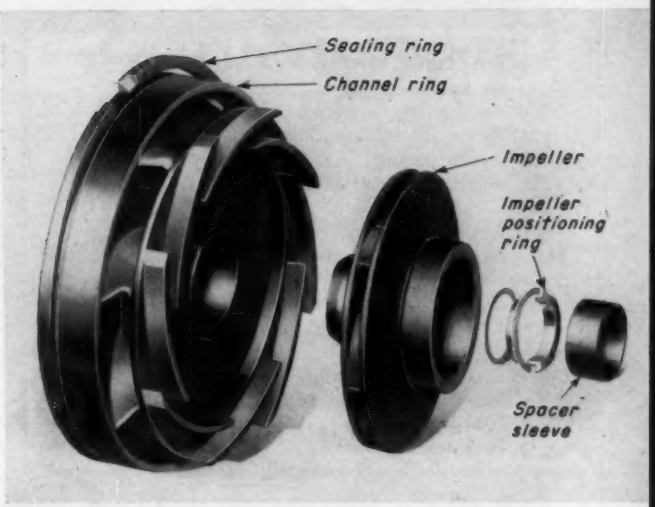
HARD-WORKING FEED PUMP gives years of troublefree service. Don't open unless capacity is lowered or faults develop

► MULTISTAGE diffuser-type split-case feed pump shown is for high-pressure service to 1200 psi and 650 F, 125 to 1600 gpm. This Ingersoll-Rand unit gives many hours of trouble-free service, but for continued heavy-duty work you should know how to open and inspect it.

Operation. Here are four general precautions you must follow when operating these pumps: (1) Always keep more liquid (as liquid, not vapor) on suction side than that needed on discharge side. (2) Always maintain enough flow through unit to prevent flashing of liquid passing through pump. At low flows much of the horsepower input is absorbed by liquid as heat. So keep flow high enough to hold temperature rise through pump at safe limit. (3) Avoid severe thermal shock to pump from sudden liquid temperature changes. Heavy metal sections of high-pressure unit cause casing temperature to lag behind liquid temperature during changes. Then severe temperature stresses and misalignment may result. (4) At all times lubricate both the bearings and stuffing-box packing or you'll have a damaged pump.

Inspection. This pump is taken apart, on an average, once in five years. But that depends on output and operating efficiency. As long as any pump performs OK and there are no symptoms of mechanical faults, thinking today is to keep





COMPLETE STAGE ASSEMBLY includes: channel ring with interstage sealing ring, channel-ring bushing and wearing ring in place; impeller; locking ring; split-type impeller positioning ring; spacer sleeve. Channel rings contain the interstage liquid passages that would otherwise have to be cast integral with the casing. Both the channel-ring bushing and the wearing ring are a press fit, locked in place for safety

case high-pressure feed pump

it is service. It costs money to rip machinery apart. Years ago, operators opened up equipment at set intervals—often found nothing wrong except that machine didn't work as well after assembly as before. Today, labor and down-time are expensive, so buy the best and keep it running until pump loses capacity or mechanical symptoms develop.

When you do open this pump, examine inside of casing halves for erosion, foreign matter, pitting, scale. Check wearing rings for clearances. This is important as your pump's capacity and efficiency depend mostly on these clearances. Some operators renew all wearing rings if clearances have gone from original 0.014 to about 0.025 in. Others find it efficient to renew all wearing rings while pump is open.

Examine bearings for condition and for wear—renew sleeves if needed. Also, make sure shaft is not excessively grooved at stuffing box, bent, etc. Look for erosion, corrosion or pitting on balancing drum, impellers, diffusers and, especially, at thin inlet tips of impellers.

Check thrust shoes and mike the thrust collar. Compare dimension with last inspection. There's little or no wear here as softer babbitt on shoes takes most wear. Look for signs of leakage between stages in casing—past metallic sealing rings. It's just common sense and good business to do an excellent job while pump is open. *(Turn page)*

CLEARANCE of wearing ring should be kept under 0.025 in. Use inside mike as here to check inside measurement

OUTSIDE MIKE on impeller hub completes story. If difference between two is excessive, pump loses capacity

Your trouble-shooting hints

No liquid delivered

a. Pump not primed
b. Speed too low; check motor voltage
c. Air leak on suction
d. Discharge head too high
e. Suction lift too high
f. Impeller plugged
g. Wrong direction of rotation

Not enough liquid delivered

a. Air leaks in suction or stuffing box
b. Speed too low
c. Suction lift too high
d. Impeller partly plugged
e. Not enough suction head for hot liquid
f. Total head too high
g. Pump defects
   A. Excessive ring clearances
   B. Damaged impeller
h. Suction not submerged enough

Not enough pressure

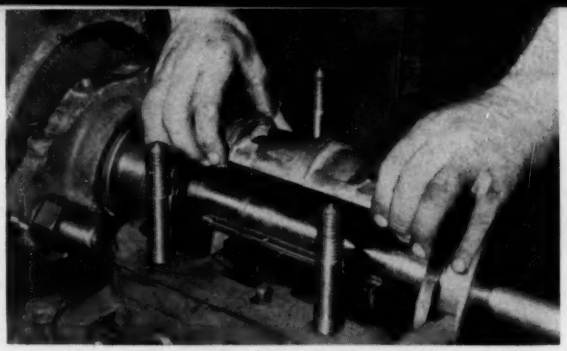
a. Speed too low
b. Air or gas in liquid; leaks on suction
c. Pump defects
   A. Excessive ring clearances
   B. Impeller diameter too small

Pump works a while, then loses suction

a. Leaky suction line
b. Liquid seal plugged
c. Suction lift too high
d. Air or gas in liquid
e. Air leaks in suction or at stuffing box

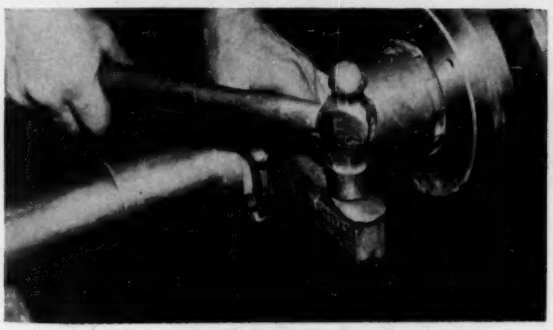
Motor runs hot (check temperature)

a Pump is taking too much power
   A. Speed too high
   B. Head lower than rating, allowing pump to handle too much liquid
   C. Liquid heavier, more viscous than rating
   D. Pump defects
      (1) Excess ring clearance
      (2) Packing too tight
      (3) Rotor binding
b. Electrical defects
   A. Voltage and frequency lower than rating
   B. Defects in motor
c. Poor installation
   A. Lack of ventilation



1 Lift out top half of bearing lining

5 Measure from balancing drum to thrust



8 Loosen balancing drum's shaft-nut

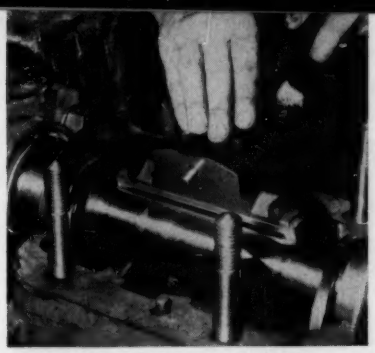
FIRST, let's open

1. At inboard end, remove coupling spacer (if used) and pump half of coupling. Disconnect all water piping to stuffing-box gland, also upper half of casing; remove top half of bearing housing. Now lift out top half of bearing bushing, Fig. 1. Prevent burrs, handle parts with care.

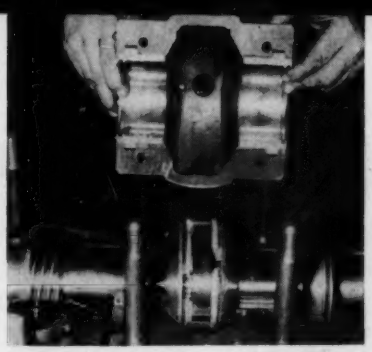
2. Roll out bottom half of bearing bushing and lining, Fig. 2. Next, remove the stuffing-box gland and packing. Don't remove inboard bottom half of bearing housing.

3. At outboard end, remove oil and water piping, bearing cover and top half of bearing housing. Lift out top half of bearing bushing and lining, roll out bottom half. Lift out thrust shoes. Remove threaded bearing housing dowels and bolts. Take off lower half of bearing housing.

4. Loosen and remove lock nut at end of shaft. You can then slide special oil-pump driving gear, aligning washers, thrust collar, adjusting shims and deflector off shaft's end,

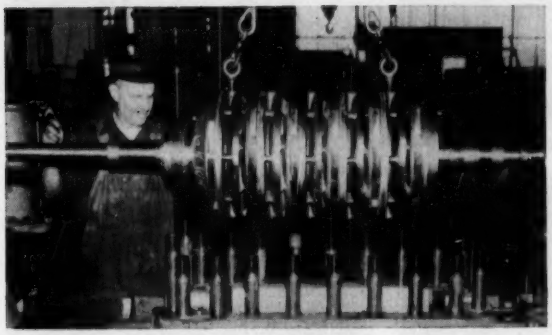


2 Roll out bottom half



3 Lift outboard bearing

4 Slide off thrust collar



6 Remove rotor assembly, as shown

7 Slide off the shaft sleeve next

9 Take out the split ring, as shown

10 Now, loosen and remove deflector

pump and inspect it thoroughly.....

Fig. 4. Aligning washers contain pins for thrust shoes. Inboard and outboard pins are of various sizes, depending on pump rotation. For easy reassembly, record the order you remove washers, as well as the other parts.

5. Remove stuffing-box gland and packing. Then unbolt and remove stuffing-box extension. Measure and record distance from inside (rubbing) face of balancing drum to shoulder of shaft that thrust collar rests against, Fig. 5. You can slip on thrust collar as shown to make this measurement. Or you can measure after rotor assembly is removed from casing, depending on your preference.

6. Remove main casing's flange nuts and dowel pins. Lift top-half of pump casing with crane, or block and tackle. Eye-bolts come with pump. Make sure channel rings are free and rotor assembly remains in position in lower half of casing before top half is removed. Screw eyebolts into top of channel rings, Fig. 6, to remove rotor assembly.

7. Rest rotor assembly on pair of horses. Back-off or remove shaft-sleeve nut. Remove packing under sleeve with packing hook. If sleeve is free axially, Fig. 7, slide off over the shaft and remove sleeve key. If sleeve is tight, first heat sleeve with torch to expand the metal for easy removal.

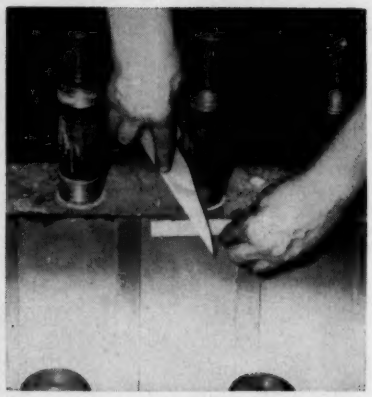
8. Next remove shaft nut at end of balancing drum with sleeve wrench, Fig. 8. Now you can remove balancing drum, balancing sleeve, drum key and adjusting shims, metallic gaskets and the O ring. Be sure to have spare O rings.

9. Slide off the last stage (high-pressure) diffuser and impeller. Next, remove impeller key, retaining washer and split ring, Fig. 9, and intermediate sleeve. Then remove next stage of channel ring, impeller, etc., to first stage.

10. Last, remove deflectors, Fig. 10, oil rings, shaft-sleeve packing, also shaft sleeve and stuffing-box bushing from the inboard end. Now parts are ready for your inspection.

1. Shims for impeller

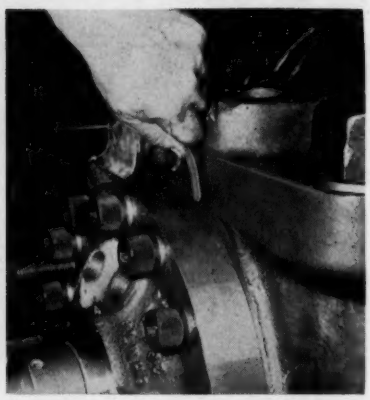
2. Tighten setscrews



3. Cut gasket as shown

6. Check impeller location

7. Pack shaft sleeve



8. Metal-to-metal joint

SECOND, now we'll close the pump, hook up

With all internal parts inspected, as explained before, we are ready to assemble the unit. Care that you take in doing this has a lot to do with the way your pump will run.

1 First, assemble split ring and retaining washer for first stage. Follow with impeller key, impeller, channel ring with metal interstage sealing ring in place, then the intermediate sleeve. Assemble remaining stages the same way until the last-stage impeller and last-stage diffuser are in place. Make sure all metal-to-metal joints are clean. Place suction ring with its sealing ring over the first-stage impeller.

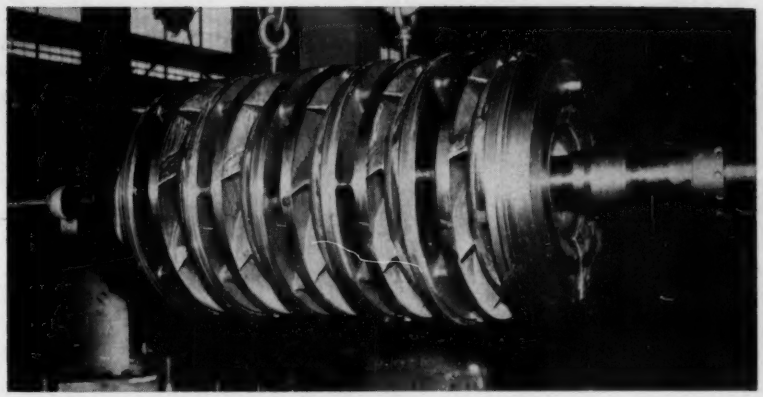
Place adjusting shims next to last-stage impeller, Fig. 1. Insert balancing drum in balancing sleeve. With O ring and metallic gasket on sleeve, slide on assembly. Follow with drum nut, but don't tighten. Check position of drum to collar. Place drum in original position. Adjust with shims.

2 At rotor's inboard end, insert shaft-sleeve key, then slide on shaft sleeve. Pack sleeve, then slide on shaft-sleeve nut and tighten: Lock in place with setscrews, Fig. 2. You can now slide deflectors and oil rings on shaft, but don't lock in position. Inboard rotor is now assembled.

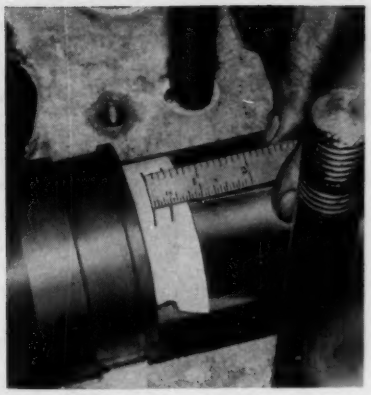
3 New casing gasket must be right thickness and material, 1/32 in. Casings are bored with metal shims between halves so gasket must be right. Place material on upper half of casing, cut holes for flange bolts and dowels. Shellac lower half of casing (don't use oil, varnish or grease). Position gasket, replace upper half of casing, tighten flange bolts. Allow three hours for gasket to set. Remove upper half of casing; use knife to cut gasket at machined fits and cored passages; Fig 3. Then cut four small gaps near outer edge for inserting feelers. Place rotor in lower half of casing, sprinkle gasket evenly with powdered graphite and replace upper half of casing. Pull down parting flange nuts evenly until gasket is compressed to figure stamped on parting flange, as measured at feeler gaps.

4 Before installing rotor assembly, Fig. 4, make sure all locating pins are in correct position—gap of each interstage sealing ring is at top. Locating pins for individual channel rings and holes for stuffing box bushing's locating pin should be at bottom of vertical center line. Line up deflectors on inboard end with bearing housing. Then lower rotor assembly into bottom half of casing. Seat all parts.

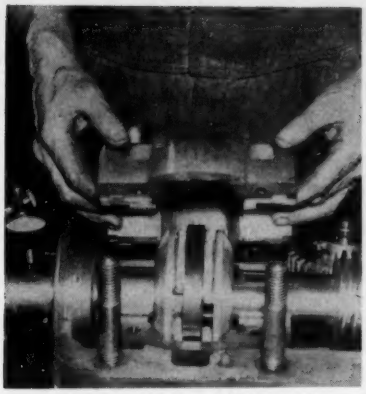
5 With rotor installed in bottom half of casing and with balancing drum and drum nut loose, check rotor end play by sliding shaft endwise with bar. Then record end play with pencil on masking tap on shaft, Fig. 5. Tighten drum nut and force drum face against sleeve face. With faces in contact, play should be about half of former figure. Rotor



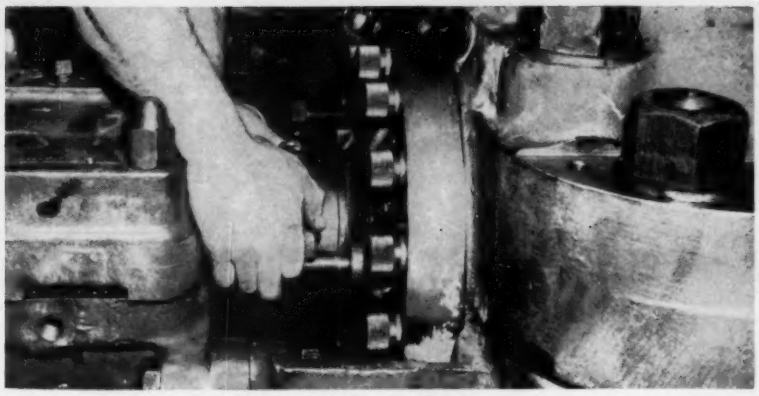
4. Lower rotor assembly into the casing



5. Measure end play



9. Add outboard bearing



10. Pack stuffing box and install gland

piping and start the unit properly.....

should be near middle of total end play. If not centered, add or remove shims between drum and last-stage impeller.

6 Reflect flexible-shaft flashlight, Fig. 6, into diffuser holes, to see location of impellers in relation to diffusers.

7 Insert shaft-sleeve key, install shaft sleeve. Pack sleeve, Fig. 7. Then slide on shaft-sleeve nut and tighten.

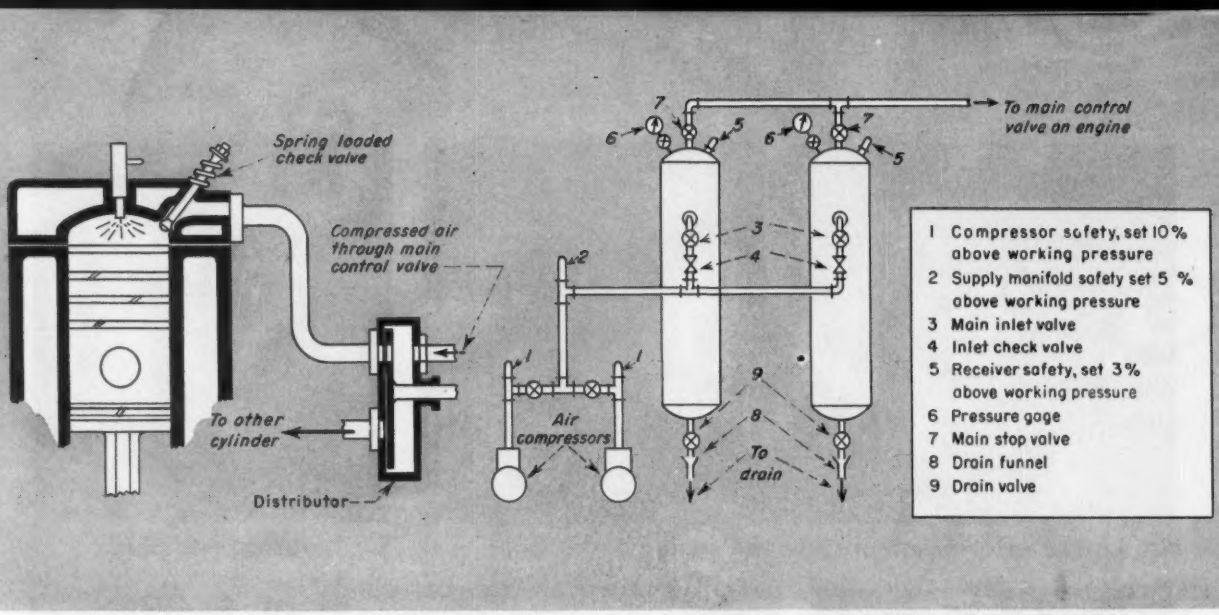
8 Install top half of casing and pull up on flange nuts. Next, insert outboard stuffing-box bushing into extension and carefully slide it into position. Pull up stuffing-box extension bolts till balancing sleeve starts to compress the metallic gasket and O ring. Tighten main parting flange nuts, compressing main gasket to dimension shown in instruction book. Measure with feelers. Pull up stuffing-box extension bolts for metal-to-metal joint against casing, Fig. 8.

9 At outboard end, put on deflector, aligning washers, thrust collar with adjusting shims, spiral gear, lock washer and lock nut. Make sure two aligning washers are installed in the same order as when removed. Bolt on the lower half of bearing housing with gear-oil pump and replace the dowels. Roll in both inboard and outboard bottom half of bearing bushings and linings. With these in position, rotor should turn freely. If not, be sure to find the cause.

Finish building the thrust bearing and set it so inboard thrust shoes contact the thrust collar 0.002 to 0.005 in. before balancing drum-face contacts the balancing sleeve face. Add or take away shims behind the collar to get this setting. When installing thrust shoes, use grease under top end only.

With bar between lower half of outboard housing and shaft-sleeve nut, force rotor inboard. This puts balancing-drum and balancing-sleeve faces in contact. Attach a dial indicator to contact inboard end of shaft, Fig. 9. Set indicator at 0. Then install thrust shoes by placing grease under toe end only. Finish building outboard bearing. Install top half of bearing and snug up two nuts, compressing bearing cover gasket. Again, force rotor inboard. Reading should be 0.002 to 0.005 in. less than original zero setting. This is clearance between drum and sleeve when inboard thrust shoes are contacting thrust collar. Adjust by removing or adding shims between thrust collar and shoulder on shaft, as explained in manufacturer's manual.

10 Set inboard deflectors for running clearance and lock in position. Install the inboard top half of bearing bushing, lining and housing. Connect all auxiliary piping and prime inboard and outboard bearing as per instruction book. Check coupling alignment, pack stuffing boxes and install glands.


Spring loaded check valve
Compressed air through main control valve
To other cylinder
Distributor
Air compressors
To drain
To main control valve on engine
1 Compressor safety, set 10% above working pressure
2 Supply manifold safety set 5 % above working pressure
3 Main inlet valve
4 Inlet check valve
5 Receiver safety, set 3% above working pressure
6 Pressure gage
7 Main stop valve
8 Drain funnel
9 Drain valve

1 In direct air-starting system, air enters cylinder through check valve in the head

2 Air compressor and receiver system needs safety valves in three different locations plus receiver inlet check valves for safe operation

Diesel starting systems

By **PAUL D HOBSON**, *Pennsylvania State University*

► DIESEL ENGINES are harder to start than spark-ignition engines. Generally they are bigger and have higher compression, and they must turn over four to eight times as fast to fire.

Low compression means no ignition. Besides, air heated by compression is simultaneously cooled by the cold engine surfaces. If the engine as a whole is below 32 F, few if any diesels will start without an external heat source or special starting fuels.

Five special systems have been devised to start diesel engines: direct air, electric, air motor, hydraulic motor and gasoline motor.

DIRECT AIR STARTING

Direct air starting is most common on engines with bore over 8 in. Compressed air, around 350 psi, is supplied direct to the cylinders through a check valve in the head and a distributor that usually consists of a rotating disk with ports. These let the air pass to each cylinder in the proper order. Ordinarily air enters the cylinder about 30 degrees after top center on the firing stroke, and cuts off about 45 degrees before bottom center. Fig. 1 shows a typical air-starting arrangement.

When starting air is admitted to all the cylinders, engine must turn with the fuel cut off. Then operator shuts off air and admits fuel while momentum turns the engine.

There are two reasons for this: (1) If engine fires with the starting-air-check valve off its seat, the valve closes with such force that serious damage may result. (2) Compressed-air expansion through the cylinder has a cooling effect, making firing difficult.

For these same reasons, another system admits starting air but no fuel to some cylinders, while the others get fuel but no starting air. When the second group is firing, starting air is cut off and fuel admitted to all cylinders.

To avoid the possibility of hanging up on dead center, the starting control sometimes has three positions. The first admits air to all cylinders. When the engine is rolling, the control is moved to the next position, cutting starting air and admitting fuel to some of the cylinders. When these are firing, the final control position cuts starting air completely and puts fuel on all cylinders.

There is such a variety of starting controls—manual, automatic, mechanical, electrical, hydraulic, pneumatic and combinations—that it is not possible to describe their operation. Consult the manufacturers' handbooks.

Air-storage system should have two receivers. This is required by classification rules in many marine installations. Sometimes the receivers are run in parallel, or the main stop on one receiver is closed but both inlet valves are open. This amounts to the same thing. If a starting error causes air loss, both receivers empty. A check valve on each receiver inlet, Fig. 2, prevents this. Many code-recommended layouts omit these check valves.

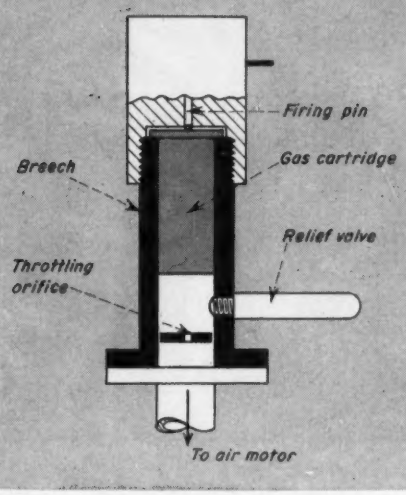
Air receivers should conform to ASME unfired pressure-vessel code specifications or their local equivalent. Do not set them direct in concrete, as external corrosion may then go unobserved.

Whether horizontal or vertical, each receiver must have a drain valve not less than ½ in. pipe size, connected to its lowest point. Discharge from the drain should be piped to an open funnel so the operator can see what is coming out. Drain receivers at least once a day.

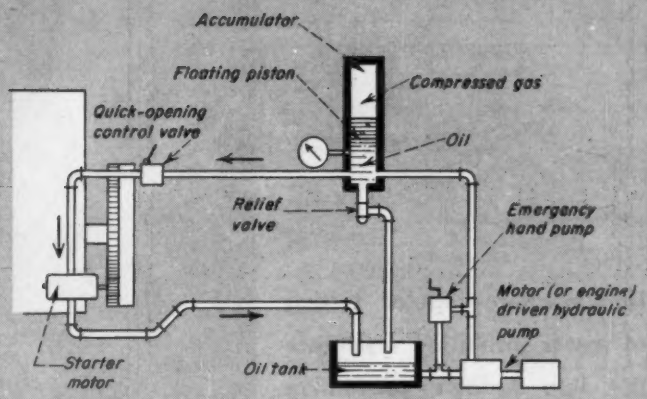
The inlet from the compressor may connect into the receiver at any convenient point as long as condensed water cannot run into it.

Delivery line to the engine should come from the top of the receiver. Each receiver needs its own pressure gage with shutoff valve or cock, and a safety valve set 3% above working pressure. This valve should permit discharging the total compressor output without letting pressure rise more than 3 to 5 psi above its setting.

Provide other safeties as in Fig. 2.



3 Gas-producing cartridge and gun provide emergency standby if air pressure is lost



4 Hydraulic system may replace electric- or air-motor starters. A pump charges accumulator to 2500 to 4000 psi; stored energy starts engine

If there is only one compressor, you can omit the safety shown as No. 1 in the figure if there is no stop valve on the compressor discharge. This safety is sometimes built into the compressor.

The receiver safeties are sometimes replaced with bursting disks set to blow about 20% above working pressure. Bursting disks save little in first cost, and all the air in the receiver goes when they blow.

Test safety valves at least once each two years, and lift them every six months, or as local safety codes specify.

Run piping in the open rather than under the floor, where it may corrode unseen. Use heavy or extra-heavy gage pipe and fittings.

Where pressures are over 300 psi, many codes forbid use of screwed-pipe connections. Even where they are legal, they are not recommended for pressure over 350 psi. Flanged joints brazed or welded to the pipes, all-welded connections, or a combination of both are generally suitable.

Flared joints may fail if there is any vibration; so may compression fittings. Soft soldered joints are definitely unsafe at these pressures. Use these joints only on pressure-gage connections and other minor lines, if at all.

Receiver capacity for about 300-psi working pressure should be a minimum of 30 times the displacement volume of one engine cylinder. At other pressures adjust the volume in inverse ratio to the absolute pressure. As a safety margin, take the working pressure as 85% of the maximum charging pressure.

Reservoir capacity should equal the sum of the requirements of the two largest engines supplied, if they do not have to start simultaneously or in rapid succession. If they do, provide the sum total of the requirements of all the engines taken separately.

High-pressure systems were once common. Receiver pressure was 1500 psi or even more; a reducing valve in the line between the receiver and the engine brought pressure down to 250 or 300 psi. This made sense when very high pressure had to be provided for blast injection. Such a system is rarely justified today.

Compressors. A motor-driven reciprocating compressor is usually the most convenient source of starting air where there is reliable electric power. For small plants, a compressor mounted on top of a horizontal receiver saves space and installation cost.

Where reliable electric supply is not available, the compressor may be driven by a gasoline or a small diesel engine.

Sometimes the main diesel engine drives the compressor. This is a useful standby, but if all the starting air is lost when the engine stops, there is no means of charging the reservoirs. You must then borrow or rent a portable compressor to recharge.

You can also recharge with high-pressure compressed air supplied by a compressed gas supplier. But be careful. There have been cases where compressed oxygen was supplied instead of air. In one such case the cylinder heads of a diesel trawler went right through the deck when the engine fired.

Compressor capacity should be enough to replace the air used in a normal start within 15 to 20 minutes. Calculate this from pressure drop in the receiver during the start.

The manufacturer or some other user can usually tell you the engine's starting air requirements. In any case, size the receiver according to the rule above.

Standby compressor capacity should be the same as the main unit when the engine has to start often. Otherwise, it is of little consequence. A very small compressor fitted on the engine sometimes helps keep a large system topped up.

ELECTRIC STARTING

Electric-starting motors similar to those fitted to gasoline engines are used on smaller diesels, like those in trucks; 12- or 24-v systems provide the necessary starting torque. High-speed 250-hp engines are about the largest that can satisfactorily start this way.

One disadvantage of battery starting is that in cold weather battery efficiency falls off quite sharply just when the engine itself is most difficult to start. Selection of battery type and size depends on the engine and starter motor characteristics, type of service, and any lighting or other loads it may have to supply. The services of a competent specialist should be obtained.

Larger engines coupled to an electric generator may be started by motoring the generator if it is a dc unit, or by using the exciter of an ac set in a similar way. Special windings are usually built into the generator or exciter for this purpose. In some installations a

(*Continued on page* 202)

ELECTRICITY

Here's where regular testing of motor insulation resistance fits into today's preventive maintenance practice

When regular motor insulation-resistance tests pay off

By NORMAN PEACH, *Assistant Editor*

► A GOOD WAY to keep ahead of motor-insulation failures is to measure insulation resistance at regular intervals and keep records. You can make tests easily and, if made carefully, they give you a lot of information on what's happening inside your motors. But cost of maintenance man-hours is high, and there'll be some conditions where insulation resistance checks are uneconomical. Trend among maintenance engineers is to omit check on small motors if incidence of breakdowns is low. (Opinions on what a *small* motor is vary from under 5 hp to under 50.)

Breakdowns will not be numerous where surroundings are clean and dry, and motors receive good care. Where majority of motors are new, there is less likelihood of insulation breakdown, especially with today's widespread use of explosionproof and totally enclosed frames. Prelubricated bearings that are popular in smaller-size motors reduce maintenance to a minimum. Of course, it's always a good idea to test insulation resistance whenever a motor is shut down for any repair, or when a replacement is taken out of stock. "Good" motors sometimes pick up a lot of condensed moisture standing around.

Maintenance engineers generally agree that regular insulation resistance measurements should be made for:

1. *Key motors.* Size of motor isn't important if its breakdown holds up a big step in production. Even a half-hour shutdown to replace a motor may cost many times the expense of a regular check that is conducted for years.

2. *Large motors.* Cost of repairs to winding goes up rapidly with horsepower. Handling becomes expensive, too, and can decide when a motor is "large" or "small." Spare motors are expensive to stock and may not be so readily interchangeable as small motors since larger investment tends to keep older motors in service. Special-design motors, even of small hp, belong here.

3. *Adverse operating conditions.* Where moisture, dirt or corrosive fumes are the natural result of industrial process, constant hazard to motor insulation causes numerous breakdowns unless insulation is tested frequently. Here it sometimes pays to check even the smallest motors. Some harmful substances, in chemical plants, for example, may be so penetrating that they occasionally creep past seals of explosionproof and totally enclosed motors.

4. *Older open-type motors.* If majority of motors are in this class, it's a good idea to watch trend in insulation resistance by keeping records.

5. *Insurance requirements.* Usually insurance company requires regular insulation-resistance tests to insure motor.

Modern testing methods

How often to test depends on hazards of surroundings. Once a year is minimum. Test can often be tied in with annual cleaning and inspection shutdown. Insurance company may prescribe frequency of measurement.

Insulation-resistance measuring instruments apply a dc voltage to insulation, and indicate resistance in megohms. Applied voltage should be at least equal to operating voltage of winding, but not higher than insulation is intended to stand. Keep in mind that maximum ac voltage is 1.41 times rated voltage, and that applied dc voltage must be high enough to subject insulation to maximum ac stress. Example: Maximum voltage on 440-volt winding is about 620 volts, therefore 500-volt dc instrument will not give adequate test of insulation strength.

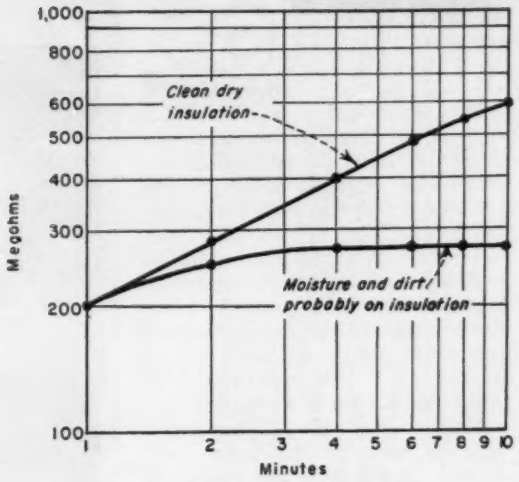
Instrument voltage should be applied for at least one minute when measuring insulation resistance. This is practical with hand-cranked instruments. If insulation is clean, dry and in good condition, resistance climbs steadily. If insulation is moist or dirty, resistance quickly levels off. Minimum acceptable resistance is generally taken as one megohm for operating voltages under 1000 volts, and one megohm per kv for higher operating voltages. With very large machines (over 1000 kw), minimum resistance standards take power rating into consideration. Refer to

POWER, June 1950, pp 116 and 117.

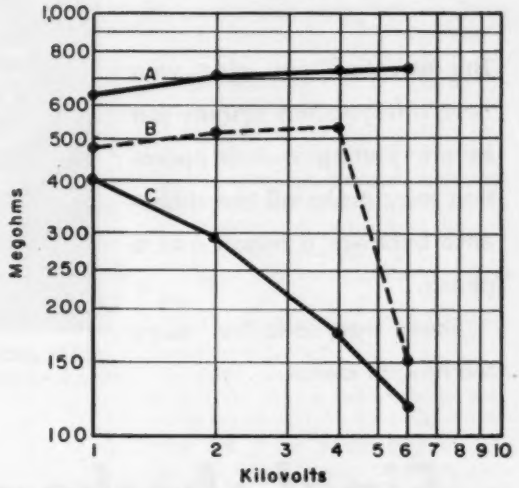
Time-resistance method (dielectric absorption) extends time of test to 10 or 15 minutes. Motor-driven or rectifier testers apply steady voltage. Record the resistance every two or three minutes as in graph, top right. Upper curve shows straight-line resistance rise of insulation in excellent condition, lower curve behavior of dirty or moist insulation. Last resistance measurement divided by first gives dielectric absorption ratio. With measurements taken at one and 10 minutes, a ratio of less than two tells you insulation needs attention. Testing at 30- and 60-second points, ratio should be 1.25 or better.

Multi-voltage method uses instrument designed for this test. Two or more voltages are applied in steps without letting voltage fall to zero. If insulation is in first-class condition, resistance remains steady, perhaps rising a little, as does curve *A*, graph, center right. Dirty, moist or deteriorated insulation has declining curve like *C* in graph. Another advantage of multivoltage test is that it reveals presence of weak spots. Resistance of these spots is high until critical voltage is reached, then resistance falls off sharply, curve *B*. Two-voltage test is sufficient to discover presence of dirt or moisture. Voltage ratio of 5 to 1 is preferable (like 500 and 2500 volts). If difference in resistance is as much as 25%, insulation needs attention. Multivoltage test can be performed faster than time-resistance test. With low-voltage windings (under 600 volts), it means that voltage considerably higher than operating voltage is applied to insulation. If resistance at first voltage is close to acceptable minimum, cleaning and drying is advisable before applying higher voltage. If insulation then fails at higher voltage, it is a fair assumption insulation has deteriorated to such an extent that it would soon break down in service.

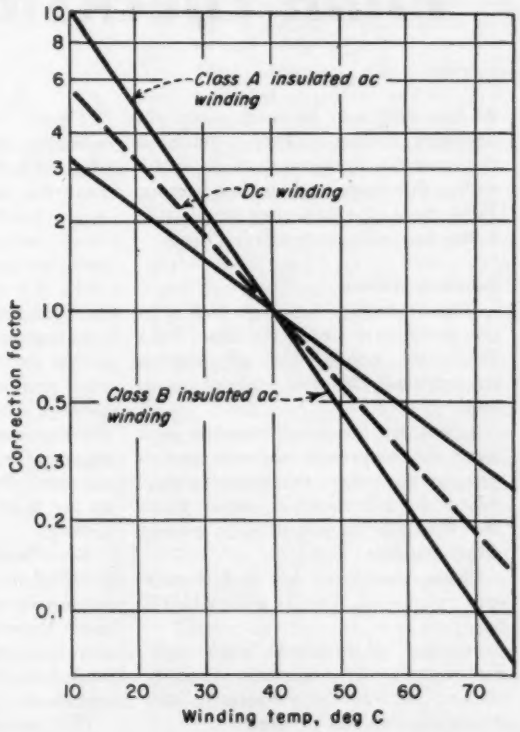
Keep records and increase value of insulation-resistance measurements. You can then watch trend in insulation's condition. A downward curve, even if readings are well above acceptable minimum, is warning against possible trouble. Recorded values should be taken at same *times* and *applied voltages*. Correction for temperature is important so records can be compared. Insulation resistance decreases rapidly as temperature goes up. Temperature of winding at time of test should be measured, and appropriate correction factor found (see chart, lower right). Divide resistance reading by correction factor to get resistance you would obtain at 40 C. When all resistance values are referred to 40 C, it's easy to observe trend of measurements across the years.



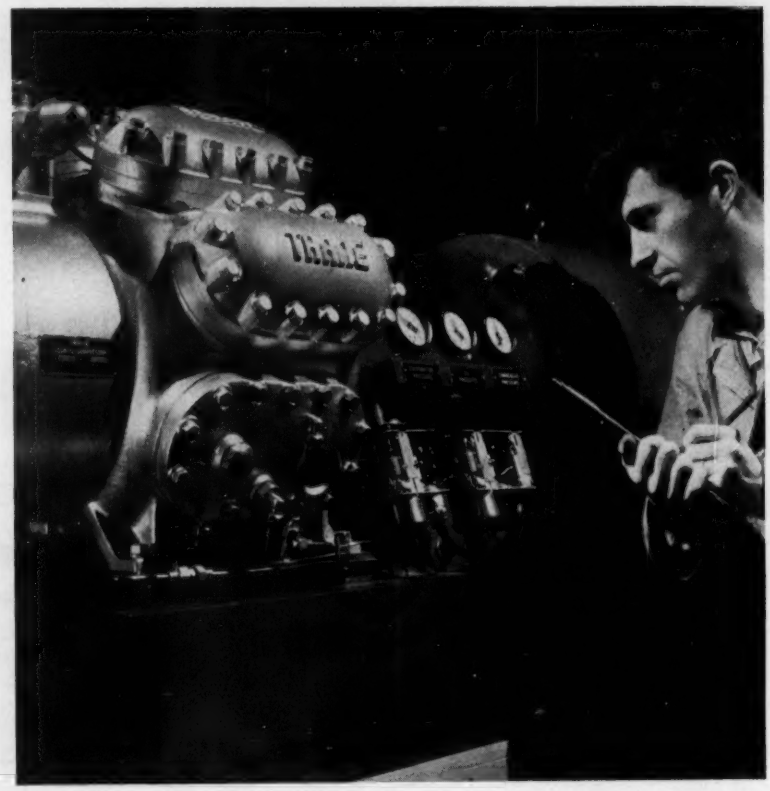
TIME — RESISTANCE. Resistance measurements are plotted to give slope of curve. Good insulation results in rising straight line



VOLTS—RESISTANCE. Flat curve *A* shows insulation is in good condition. Curves *B* and C indicate undesirable conditions



TEMPERATURE DATA. Approximate correction factors for three general types of insulation referred to 40 C as base temperature



START AND STOP the compressor several times at 10-second intervals before running in. Read compressor pressure gages. Correct operating difficulties before proceeding

The attention you give your new refrigeration system just before putting it into operation may make all the difference between a lemon and a peach.

These easy-to-follow steps tell how to make . . .

Final checks and adjustments on

► THE BEST WAY to avoid costly and annoying shutdowns after a refrigeration system is operating is to go over it with a fine-tooth comb before starting. Then check it again after running 72 hours and once more after a week.

Before operation:

Before starting your new refrigeration compressor for the first time, check the entire system. Put all controls through their complete cycle of operation.

Adjust the low-pressure switch so it starts the compressor whenever suction pressure rises above the desired setting. Adjust the differential or cutout points as low as the job will stand to prevent short-cycling.

Check cutout point for the high-pressure switch, too. This is generally 175 psi.

See that all interlocks work right. For example, the compressor should be "locked out" if the evaporative condenser fails to run properly.

Check the thermostatic expansion valve for proper superheat adjustment. Put a thermometer on the suction line near the remote bulb of the thermostatic valve (sketches, facing page). Read refrigerant temperature at a point as near the remote bulb as possible, but on the compressor side of both the remote bulb and the external-equalizer-line connection.

You get the most accurate temperature reading by using a thermometer well. If no well is provided, attach thermometer with duct seal or use a clip-on-type thermometer. In these last two methods, reading accuracy depends on the bond between thermometer and pipe.

Read the suction pressure at the gage installed in the back-seat port of the compressor suction valve. Difference between thermometer reading on the suction line and the temperature calculated from the suction pressure is the superheat.

This method does not consider any pressure drop in the low side of the system. If you suspect abnormal pressure drop, take steps to measure it and determine its effect.

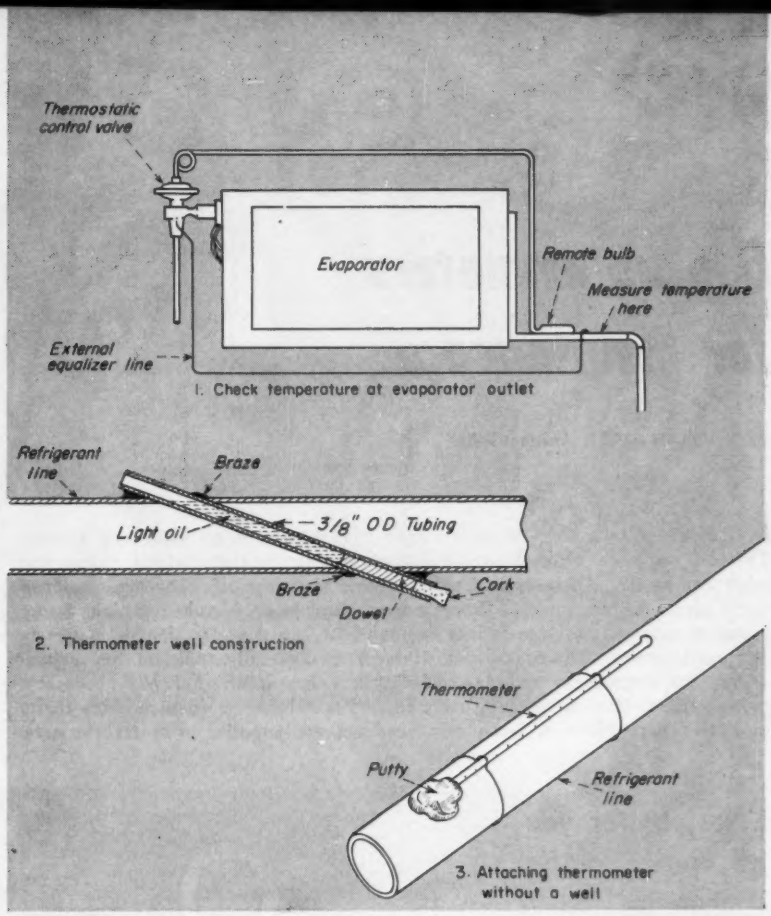
One method for measuring pressure drop is to install a tee at the connection between the thermostatic expansion-valve external-equalizer line and the suction line proper. Connect a refrigeration compound gage to this tee. This gives the true pressure reading at the evaporator outlet. Gage readings can then be used for obtaining superheat measurements.

Most air-conditioning installations have superheat settings of about 10 degrees.

Also, check head pressure. If it is too high, adjust the water-regulating valve for increased flow. If head pressure is too low, adjust valve so that the water flow will be reduced.

Set thermostat to maintain desired temperature in the area to be cooled.

Just before starting the system, check for the following conditions:



USE THERMOMETER WELL to get most accurate reading of refrigerant temperature. Otherwise, tie thermometer on line, use putty to insulate bulb from the atmosphere

refrigeration systems

1. Shutoff valve on water line to shell-and-tube condenser open.
2. Oil in compressor at or above center of sight glass.
3. Compressor suction and discharge valves open.
4. All moving parts free to move. (Check by turning compressor over by hand several times from the drive coupling.)
5. All shutoff valves open except bypass valves installed for other purposes.
6. Solenoid stop valve on magnetic coil control.
7. All compressor suction, discharge and oil-pressure gages connected and open to read operating pressures.
8. Readings on compressor pressure gages OK when compressor is started and stopped several times at 10-second intervals. (Correct any operating difficulties before proceeding.)

After making these checks, let system run normally for at least 72 hours before making a final check.

During 72-hour run-in:

Mechanic should stay on the job continuously for at least 48 hours of the 72-hour run-in period. Here are the things he should do:

1. Keep a close watch on oil level in the compressor, never permitting unit to run short of oil.
2. Immediately after starting, take amperage and voltage readings on all motors to determine that they are running at nameplate conditions.
3. Check entire system for leaks several times during the 72-hour run-in.
4. Check all controls for proper operation; reset if necessary; see that they are calibrated.
5. Observe and record all operating pressures and temperatures.
6. Check superheat setting of the thermostatic expansion valve; adjust if necessary.
7. Adjust and set compressor capacity control system. Even though this may be preset at the factory it should be reset if necessary.

After 72 hours:

Here are the points to check after system has run 72 hours:

1. Compressor oil level. If low, do not add oil immediately, but operate the system three or four hours and check frequently to see that returning oil does not restore the proper level. If oil has not returned at the end of four hours, add some. If oil is at the proper level on starting, check frequently during the 3- or 4-hour run to see that level stays constant.
2. Refrigerant flow at the sight glass. Flow should be solid with no bubbles. These indicate a refrigerant shortage. If bubbles are present now, there is probably a leak, and system should be checked completely with a halide torch.
3. Liquid line from receiver to expansion valve. See that there is no appreciable temperature change over the length of the line. If a strainer or stop valve has a warm inlet and cold outlet, there is restricted flow or inadequate subcooling. If liquid is properly subcooled, there is an obstruction. Remove and clean the obstructed part.
4. Superheat setting of the expansion valve.
5. Adjustment of the evaporator pressure regulator valve.
6. Head and suction pressure. If correct, the suction and discharge shutoff valves should be back-seated. Remove test gages (unless they are permanent) and plug gage tappings.
7. Compressor seal. Stop system and test seal with a halide torch to be sure it is holding tight.
8. Motor alignment. Check compressor motor for alignment and adequate lubrication. Avoid over-lubrication.
9. Clean the water strainer ahead of the water-regulating valve.
10. Air-handling units. Adjust belts for proper tension and check alignment. Check for adequate lubrication. Avoid over-lubrication. Check air filters to be sure they are clean.

After one week:

1. Drain compressor crankcase. Remove inspection plate and thoroughly clean crankcase, swab out with carbon tetrachloride or similar cleaner. Then recharge with clean, new compressor oil, as specified by the manufacturer.
2. Tighten bolts in the coupling between compressor and motor.
3. Clean all filters in the entire system both in the compressor and liquid line.

Do not take these steps at the time of the 72-hour check. More regular running time is needed to clear the system of foreign material.

—Courtesy, The Trane Company

Plant Electrical Fact File

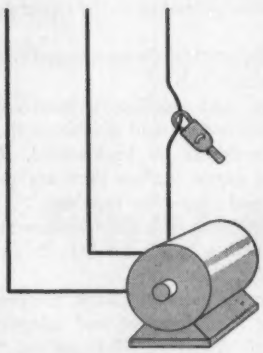
No. 4: AC AMMETERS

Use ac ammeters for maintenance

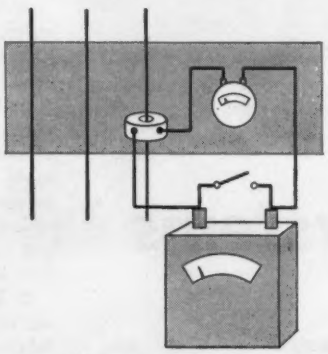
BY NORMAN PEACH, *Assistant Editor*

► ELECTRIC MEASURING INSTRUMENTS are a good investment for plant maintenance. They let you know what's going on inside your motors, transformers, cables and other equipment. Ammeter and voltmeter are most useful. They are combined in ac clamp-on instruments. Where currents are large or voltages high, 5-amp ammeter with current transformer is your best bet. Construction of ammeters varies. Accuracy of inexpensive instruments is generally sufficient for maintenance, but ruggedness and dependability are important. For high accuracy, compensations must be made in using current transformers. In such cases charts indicating corrections in instrument readings are supplied with transformers.

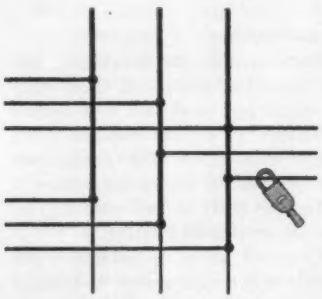
An ac ammeter will do these jobs for you



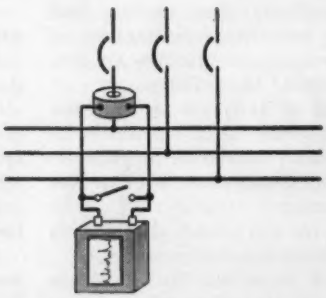
MOTOR CURRENT CHECK shows up suspected overload. Where load is adjustable, as with pumps, safe maximum can be set with ammeter. Shorted winding is indicated by unequal phase currents



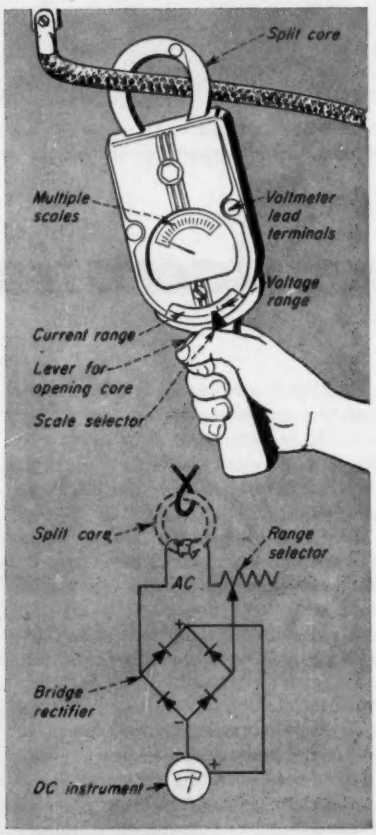
PANEL INSTRUMENT CALIBRATION at regular intervals is good maintenance practice. With accurate test ammeter it's easy to spot a panel instrument that is giving a false current reading



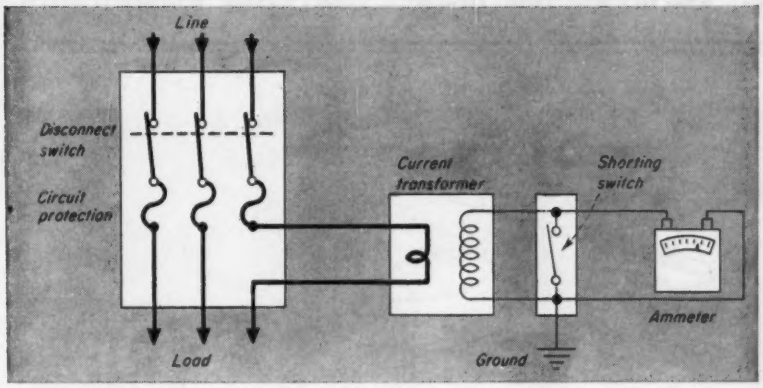
STUDY LOAD on branch circuits to avoid overloading and take advantage of underloaded lines. Ammeter locates which units are contributing to load, indicates reserve capacity of other lines



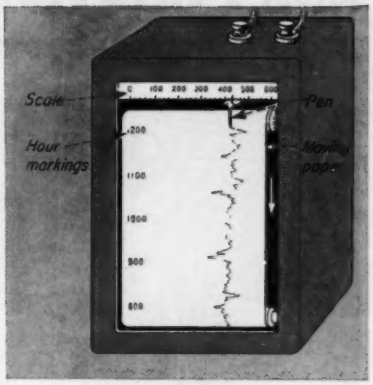
DEMAND STUDY can be made with recording ammeter if voltage and power factor are constant. By finding peak-load time for each circuit, process cycle may often be changed to reduce demand



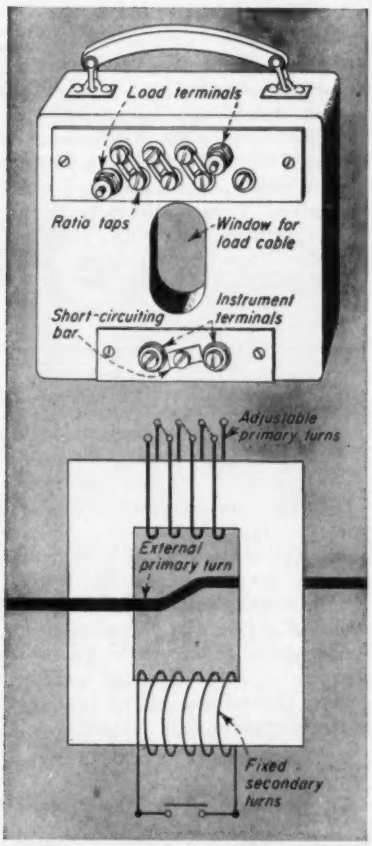
CLAMP-ON AMMETER is most practical type for circuits up to 300 amp, 600 volts. Measures current quickly without opening connections. Multiple scales make possible close readings in wide range. Most models serve also as voltmeter using leads. Instrument is dc milliammeter employing rectifier for ac



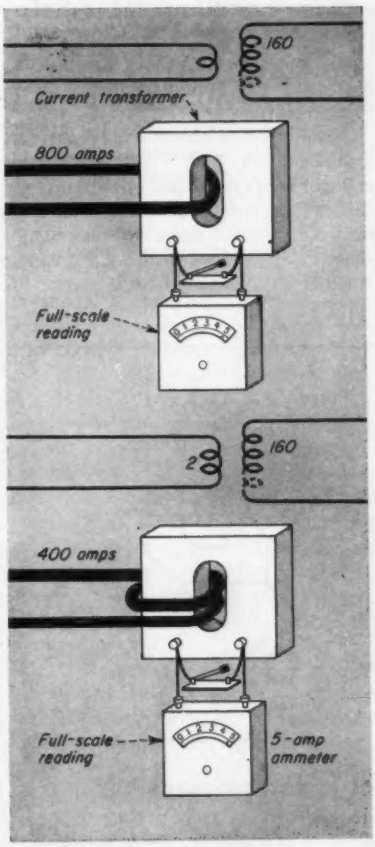
BASIC HOOKUP for ac ammeter with current transformer. Circuit may be cut into as shown at right, below, but circuit protection must be maintained. Choose instrument range to match circuit protection so current surge will not damage ammeter. Locate current transformer away from stray magnetic fields that might influence readings. Grounding of instrument circuit is recommended. Always connect shorting switch to prevent high open-circuit voltage on current transformer secondary coils



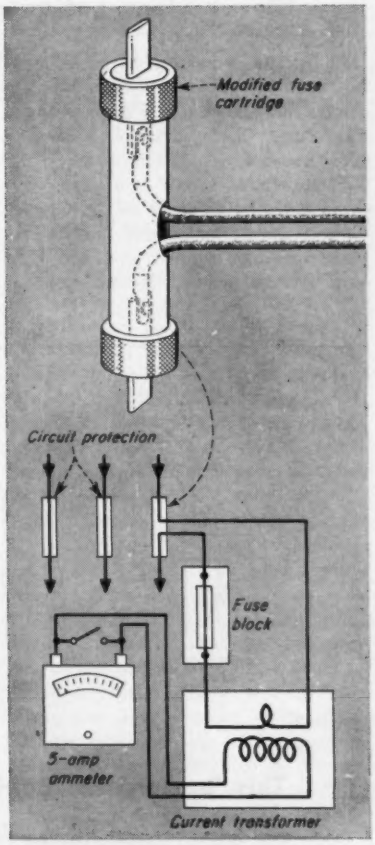
RECORDING AMMETER plots current values against time on continuous chart. Chart drive mechanism is accurately synchronized with time. Pen movement is proportional to current. Some recording ammeters have disk-shaped charts.



PORTABLE CURRENT TRANSFORMER permits measurement of large amperages with 5-amp meter, isolates high voltage. Taps on internal primary give ratio choice. For very large currents conductor passed through window becomes primary. Shorting bar prevents high-voltage buildup on open circuit

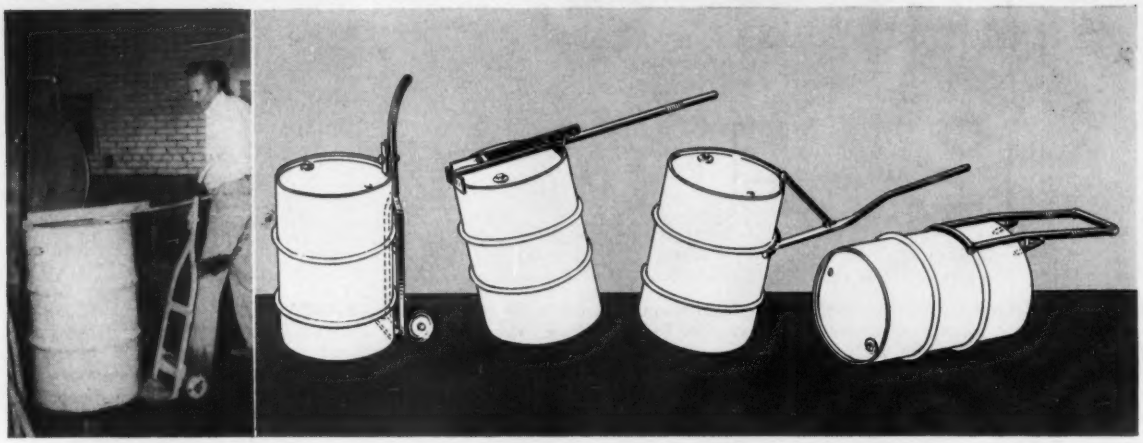


CURRENT-RATIO CHANGES for high current range can be made by looping primary conductor several times through window. Makes full-scale readings possible with different load currents. To avoid danger of high-voltage buildup, always keep short-circuiting switch closed until ready to take the ammeter readings



CUT INTO CIRCUIT with minimum service disruption. Best place is often at fuse cutout, with test circuit connected by clamps or fuse cartridge modified as shown. Fuse block in test circuit maintains circuit protection. Sometimes circuit-breaker current transformer can be used in place of instrument transformer

Latest PRACTICAL IDEAS to make your job easier . . .



Clever idea: Let handy drum-handling tools help with those heavy jobs

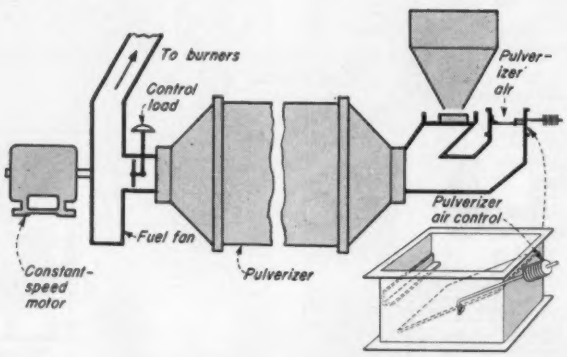
Handling oil drums can be back-breaking, even for two men. Then there is always the chance that a drum will get away and cause damage. Sketches show how I solved this problem.

First sketch shows how clamp on drum dolly holds drum so you can let it down gently on painted floors. Just place one foot against axle and hold back on the handle. Normally, drum would bang down, chipping paint, denting wood and even damaging nearby equipment.

Second sketch shows handy part of drum-handling tool. This gives you enough leverage to tilt full drums, so you can get dolly under one end. One man thus tilts the drum with one hand, shoves dolly under with other hand. Another drum-tilting tool is shown in third sketch. This one pulls the drum toward the operator.

Fourth sketch shows another tool for lifting full drums while in a horizontal position. This must often be done when one man moves a full drum into a certain position. In each case, tools shown must fit the drum accurately. You can make these tools from piping as I did.

D L COCHRANE *Cambridge, Minn.*



This 'homemade' control is for primary air

I made this device to control primary air that's conveyed under a positive pressure to coal pulverizer. Pulverizer operates under a negative pressure. This control has operated six years. It's as good and foolproof as any similar commercial control on the market.

Anyone handy with an acetylene torch or an electric welding machine can construct this control in a few hours. For best results, it should be of square design, sketch. It should also have slightly larger volume than the supply duct to the control. Then balance the counterweight against pressure of primary air as shown.

When fuel fan and pulverizer are started, pressure drop across damper operates the control. By moving counterweight toward fulcrum, or away from it, any desired pressure can be maintained in pulverizer.

Sketch shows position of fulcrum in proportion for this size control. It can be built any size to meet existing conditions. But take care when building. Damper should be centered so it doesn't touch control sides. You can use any common, loose-fitting sleeve bearings for the fulcrum of your damper.

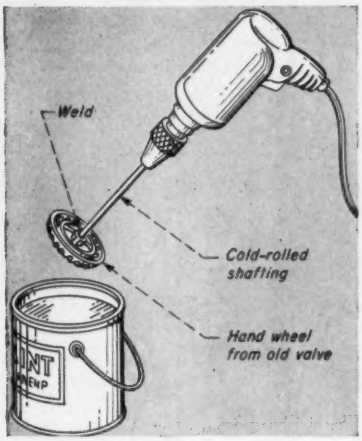
G. ANDRIKUT *Newton Falls, N .Y.*

Did you know . . .

that fumigating processes introduce serious fire hazards? Reason is that flammable fumigants create an explosive atmosphere. Then the extremely toxic nature of the fumigants prevents effective firefighting. Keep this in mind.

keep your plant in tiptop shape

STEVE ELONKA, *Associate Editor*



Easy paint mixer

Sketch shows very simple device for mixing paint. You can make it in a few minutes. Just chuck in electric drill and use. You'll be amazed how thoroughly it mixes in two minutes very stubborn and heavy paint that usually takes 20 minutes by hand.

E H BURK *Port Ontario, Ont.*

Report to operators

We had display board, photo, installed two years ago in a very prominent place in our plant. Now, all plant visitors are interested in it and it's also a report to our various plant operators.

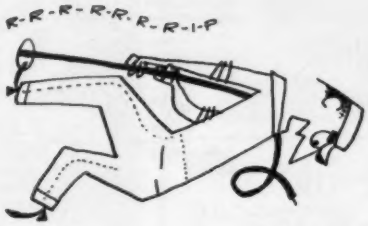
S C STICKNEY *Tonawanda, N. Y.*

Perpetual motion?

With POWER's checks for Practical Ideas I have bought a flash camera and typewriter with which to bring in more POWER checks.

D L COCHRANE *Cambridge, Minn.*

Don: Keep up the good work. Hope you continue to receive checks from us for many years to come.—Steve



What would you have done?

One morning, No. 5 circuit breaker tripped, shut down entire grinding and sand-blasting department. Breaker was closed, no further trouble. Two days later, No. 5 tripped again. Electrician checked the circuit's resistance, found it plenty high and OK. He closed breaker. No trouble for two weeks, then out went the circuit again.

Super said a few nasty words about careless maintenance gang, also dumb electricians. Operators taking power from No. 5 were questioned. No help. There had been no abnormal load, signs of flash, smoke or anything else unusual.

A month passed — no trouble. Then No. 5 circuit went out. Electrician made quick test, but line was clear, breaker closed again. No reason was discovered for these outages. They didn't jibe with anything except that No. 4 air furnace had been running every time the circuit tripped. But as No. 5 circuit supplied no power to the foundry, there seemed no connection. True, circuit passed through foundry but the 3-phase cables were protected in steel conduit, which was clamped to roof truss. But electrician crawled along truss and felt conduit. Conduit and truss were hot but temperature was OK. "Maybe 130 F," said the electrician. No branch fuses or motor circuit breakers had opened with the circuit breaker. For an added check, electrician connected a fuse in each phase. He did this so he could learn if trouble was in any one phase, or in all phases when short occurred.

Next morning electrician learned that trouble was in "B" phase for only that fuse blew. Five outages occurred during next month. All were on phase B. Maintenance engineer decided to pull the No. 5 3-phase cables out of conduit where it crossed the foundry. He ordered it done on Sunday. Electricians thought idea idiotic. Super said nothing, but indicated a man-to-man talk with maintenance engineer if no cure resulted. It did seem that rubber-insulated 3-phase cables were completely protected by the strong steel conduit, 20 feet in the air. It seemed the last spot to look for trouble, not the first.

Sunday the cables slowly slid out of the conduit. Then a portion came along with an 18-in. strip of rubber carved off. That occurred when the cables were originally pulled in place. Along this bare strip there were many burned and flashed spots. It was the phase-B cable.

When cable was pulled into conduit, sharp fin at end had acted like a carving knife and sliced off the long strip about half an inch wide, exposing the bare copper. This uninsulated place was on top of the three cables. It caused no trouble for several years, then as power load increased, cables became warmer. Since copper expands about 50% more than steel, increase in length added to that caused by heat of air furnace. Then cable buckled, contacting conduit. Grounded conduit thus caused a dead short. Flash blew contacts apart again while tripping the circuit breaker. That automatically cleared the line without giving evidence where shorts were. Cable was carefully reinsulated and returned to its place. Solving problem took three months. Perhaps it was not tackled in the best way. What would *you* have done?

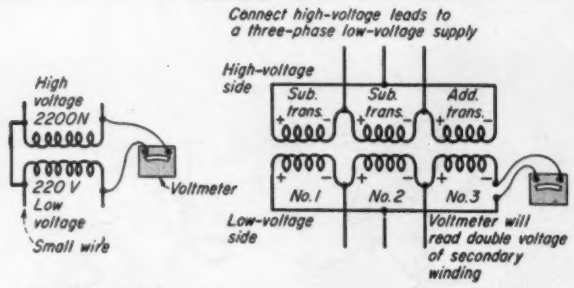
G P PEARCE *Albuquerque, N. M.*

Turn page for more Ideas

PLAN AHEAD

More PRACTICAL IDEAS

Begins on page 124



CHECKING POLARITY OF SINGLE-PHASE TRANSFORMER

'CORNER DELTA' CHECK

Here are practical hookup hints for transformers

Electrical men often run into trouble when connecting transformers of different makes—especially ancient units found on construction jobs.

Suppose you have to hook up three transformers to give 2200/220 volts, 3-phase, delta-delta. Electrician assumes polarity of each transformer is the same, so connects them according to standard procedure. He closes the switch on the high-voltage side. Bingo. A fuse or perhaps the oil breaker opens. Something is amiss, that's for sure.

If we assume ratios are correct and transformers OK, chances are he's dealing with opposite polarities. (On modern transformers the polarity is indicated on the nameplate—not so with old ones.)

First sketch shows a simple method for checking single-phase polarity. Connect small wire between one high-voltage side to opposite low-voltage side. Apply low-voltage to high-voltage winding and connect voltmeter as shown. With 220 volts applied to the high-voltage side, the voltmeter reads 220 plus 22, or 242 volts for an additive transformer of this type.

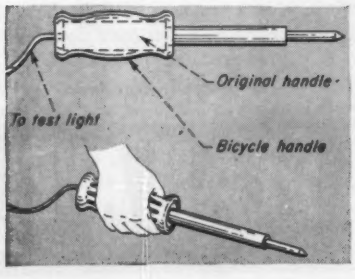
For a subtractive transformer, it reads 220 minus 22, or 198 volts. Caution! Always use the lowest voltage that gives a normal reading.

Second sketch shows the "corner of the delta" check. This is highly recommended as a final check, especially on larger banks. On a balanced bank of transformers, voltmeter should read zero. If one transformer is of opposite polarity, or incorrectly connected, you'll have double voltage. Investigate even a small indication by the voltmeter, for this could mean that one transformer in the bank is connected to the wrong taps. But this should show up if ratio check is carried out properly.

I once saw an old electrician, with no voltmeter, determine if his transformers were connected correctly. He merely inserted a short piece of fuse wire in lieu of a voltmeter. If the fuse blew, it was wrong; if not, things were OK. I can imagine our friend Marmy pulling such a stunt. Fact is, I've done it myself in a tight spot.

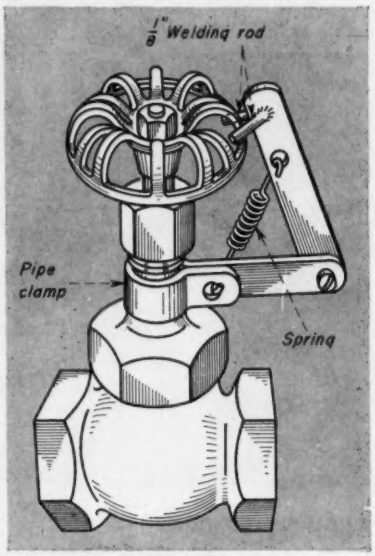
L McWilliams
Shawinigan Falls, Q.

Use bicycle grips on test light



Double-insulating your test-light sticker-handles with tape becomes a messy, soggy job when handled with greasy or oily hands. Try slipping a bicycle-handle grip over your present sticker handles, sketch. Grip shown not only gives you excellent protection from high voltage, but also is easily cleaned and resists oil and grease. Bicycle grips come in many sizes, colors, and can be used for various jobs.

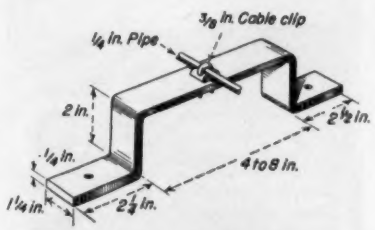
F Lettino *Astoria, N. Y.*



Handy valve lock

Here's an idea to keep valves at a specified setting. It's also handy to use where excessive vibrations cause valves to open or close as often happens.

J Gammuto *Westmont, Ill.*



Brackets for small pipes

First make a bracket of 1¼x¼-in. strap iron, sketch. Then use cable clip to fit the pipe. Cable clip's base may have to be filed slightly for a good fit. Drill holes in strap iron to take clip. Also, drill hole in each end of bracket so you can fasten it to wall. I drive bracket studs with a stud gun.

Clamp shown is stronger than conduit clamp, and much better than strap-iron clamp. I use them on ¼-in. air lines mounted on wall, with quick connectors on ends. While these get a lot of pulling, etc, they seem to stand up very well. Bracket shown is used on pipes up to about ¾ in., but price of clips may prohibit use in larger sizes.

Pipe size: ⅛, ¼, ⅜, ½, ¾ in. Clip size: 5/16, ⅜, ½, ⅞, 1⅛ in.

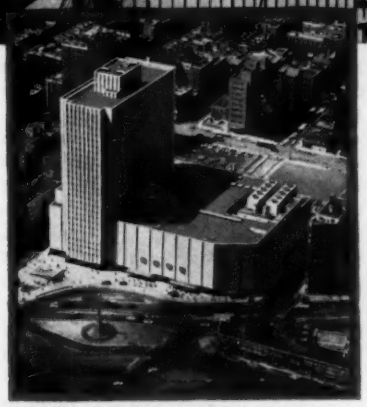
W G Gibson *Vancouver, B.C.*

Turn page for more Ideas

New York Coliseum

This $35 million structure has a 26 story office building, a large underground garage, and a 9 acre four level exhibition area with the most modern facilities obtainable.

Exposition Capital of the World



New landmark dominates Columbus Circle

OWNER
Triborough Bridge & Tunnel Authority
ARCHITECT — **Leon and Lionel Levy**
MECHANICAL ENGINEER — **Guy B. Panero**
GENERAL CONTRACTOR
Walsh-Fuller-Slattery
HEATING, VENTILATING AND AIR CONDITIONING CONTRACTOR
Almirall & Company, Inc.

Other Famous Showplaces Using Powers Air-Conditioning Control

Madison Square Garden • Radio City Music Hall • UN General Assembly Hall Coliseums in Houston and Syracuse

(c76)

Another Famous Showplace Equipped with

POWERS

Control Systems for Heating Ventilating and Air Conditioning

Versatility of Powers Control meets the varied needs of this unique building. A million visitors and exhibitors annually will enjoy its air-conditioned comfort.

Ten cooling towers on the Coliseum roof provide condenser cooling water for 4100 tons of refrigeration. Four centrifugal compressors carry the cooling load. Interconnection of the cooling and chilled water circuits permits compressors to serve either the offices or Coliseum.

The large Coliseum areas are supplied by high velocity single zone air systems while the small meeting rooms, office areas, etc. are served by low pressure fan units and by high velocity double duct systems. One of the 7 Powers Control panels is shown above.

In the office building, occupants can dial the temperature they wish. Individual space control is obtained with 550 Powers Heating-Cooling Thermostats regulating 1400 unit air-conditioner valves. Interior zones are served by high velocity air systems.

Consult Powers when you have a temperature or humidity control problem for a new or existing building. You can benefit from our 65 years of experience gained in all types of buildings.

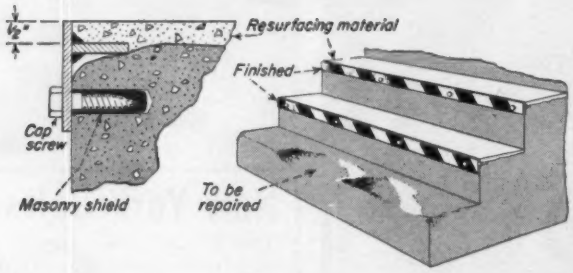
THE POWERS REGULATOR COMPANY

SKOKIE, ILLINOIS | *Offices in chief cities in U.S.A., Canada and Mexico See your phone book*

65 years of Automatic Temperature and Humidity Control

More PRACTICAL IDEAS

Begins on page 124



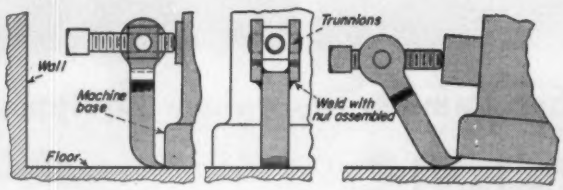
Repair your plant's concrete steps right

Concrete steps doing heavy duty may get dangerous with time. Steps become dished across their width and rounded on front edge of tread. My experience is that thick build-up patching on treads seldom makes a lasting repair.

Solution is to apply a bull-nose, sketch. Then you can resurface steps so they are sturdy. Materials needed are: strap iron in 1-in. and 2-in. widths of ⅛-in. thickness. After cutting strap iron to step's length, weld the 1-in. widths to the 2-in. material at right angles as shown, ½ in. from end. Attach this bull-nose to step with cap-screws threaded into lead shields.

You will get service from any good hard-floor resurfacing materials, applied strictly as manufacturer directs. Paint the exposed metal with a good traffic-marking paint. That protects metal from rusting and makes steps easier to see. Thus they are safer.

A PERLINGER *Pittsburgh, Pa.*

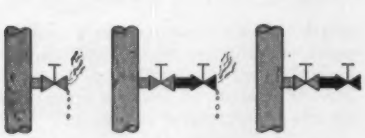


Screw-powered crowbar lifts heavy weights

When moving machinery, you often have to first insert a crowbar's point under the machine's base to raise machine from floor. Once raised, you can slip wedges under base to hold it up while placing rollers, etc, in position.

For a heavy machine, a strong long crowbar is needed for right leverage. But you can't often use a long bar if machine's foot is close to a wall, etc. My bar, sketch, solves that problem. Use it as shown and your problem is solved. Every plant should have one.

C T BOWER *London, England*

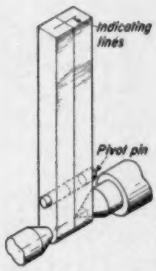


Stop live steam leak

You can stop leak from valve tied into live steam line when leak is too great to use plug or when plug is impractical. Simple though it seems, I am surprised that so few engineers know this. Use a second valve with a short nipple, as in sketch.

Then open the second valve, screw it into the leaky valve with steam blowing through. When second valve and short nipple are tightly secured, shut off second valve to stop leak. Repair leaky valve at a convenient time.

J A SPENCER *Winston-Salem, N. C.*



Handy tool to align lathe centers

After lathe centers are set out of line for taper turning, you have to align them for parallel work. Simple gadget is two pieces of ⅝-in.-square bar steel, sketch. Place side by side and connect with a snug-fitting pivot pin. Pin can be a standard hardened dowel, fitted into reamed holes.

Drill center holes (in line) in pieces for lathe centers. First, surfacegrind bars at least on contacting faces. Then, clamp pieces together; drill and ream dowel holes.

Drill one center hole, then drill the other by locating existing hole on lathe tailstock center. Drill by securing center drill to revolving lathe spindle. Be sure lathe centers have been realigned with bar and dial gage. Then mount tool between the aligned centers as shown. Grind surfaces smooth to show the fine line.

To use tool, position it between lathe centers, as shown. Misalignment throws scribed lines out of line. An error in center alignment is magnified. For example, if bars are over 6 in. long and distance between center holes and pivot pin is 1 in., magnificaton of error is five times greater. Error in lathe-center alignment of 0.001 in. shows a gap of 0.005 in. between two lines. You can see such an error easily with the naked eye. Make all lathe-center alignment tests with your tailstock and spindle clamps tightened for best results.

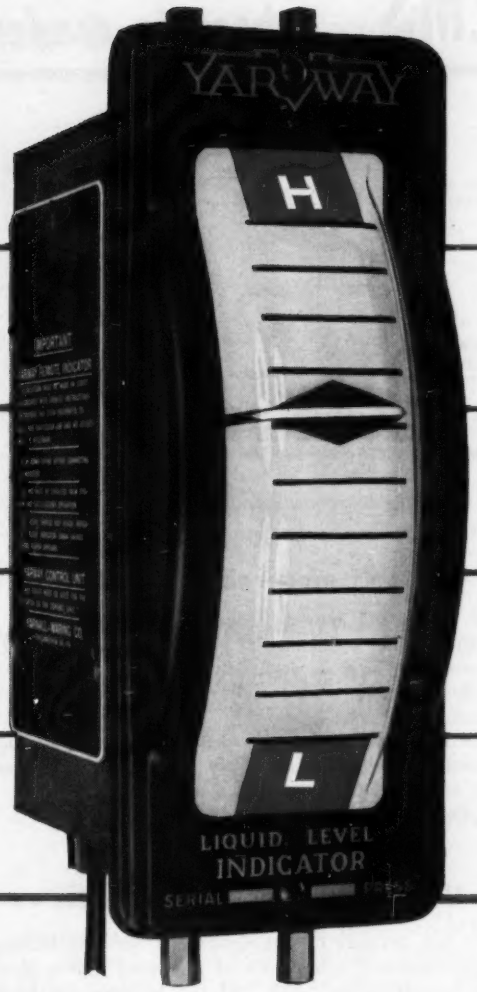
C T BOWER *London, England*

Did you know . . .

that burning magnesium isn't affected by ordinary extinguishing agents? Not only that, but also spraying water on it actually accelerates the burning.

My biggest boner . . .

Please turn to page 186



boiler water levels now easier to **see**... easier to **read**

Whatever the boiler pressure, high or low, YARWAY Remote Indicators give accurate, instant, eye level boiler water level readings at any convenient plant location.

Boiler Code Case No. 1155* says in part, "... two independent remote level indicators of the compensated manometric type may be used instead of one of two required gage glasses for boiler drum water level indication in the case of power boilers with all drum safety valves set at or above 900 psi..."

YARWAY Remote Liquid Level Indicators fill the bill—and feature a "wide vision" face that makes reading easier from any angle.

Accurate—because indicator is actuated by the boiler water itself—by the pressure differential between a constant head and the varying head of water in the boiler drum.

Also use YARWAY Remote Indicators on heaters of various types.

For full description, write for YARWAY Bulletin WG-1824.

*Write for free reprint of case description.

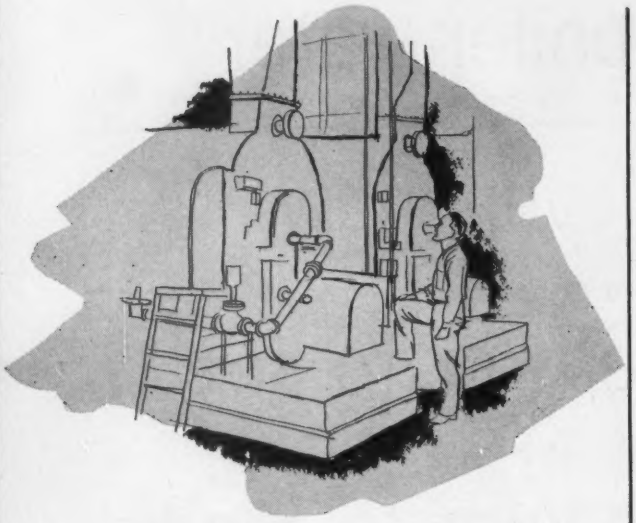
Yarway Remote Hi-Lo Alarm Signals—lights or horns—can be used with Yarway Remote Liquid Level Indicator and placed at any location in the plant.

YARNALL-WARING COMPANY

100 Mermaid Avenue, Philadelphia 18, Penna.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY® REMOTE LIQUID LEVEL INDICATORS

PLANT PROBLEMS... here is readers'



The question

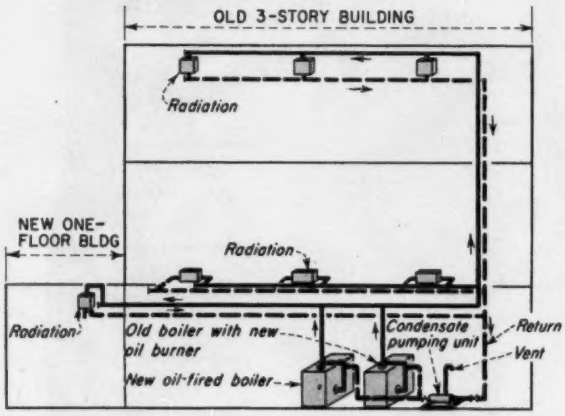
How can I modernize our building heating system?

I'm plant engineer for an electrical-equipment manufacturing company that's experienced a rapid growth during the last five years. We plan to pick up needed production space by adding a one-floor building about 150 ft square, next to our old building, which is a 3-story structure about 200 ft square.

Steam-heating system, put in about 30 years ago, needs modernizing badly. Two old low-pressure heating boilers have underfeed stokers. Ash removal is manual. Steam-distribution system, drainage, venting and control are inadequate by today's standards.

We'd like to take advantage of summer shutdown to do a complete system revamping. And, at the same time, we'll provide heating for the new building too. We plan to add a new boiler, condensate-return pump, etc. We're also considering oil firing. Have readers system design tips or experiences of their own to offer?—*SJT, April Power*

The answers



Don't modernize... Replace

Most 30-year-old systems need replacing rather than modernizing. The approximate useful life, considering obsolescence as well as deterioration, would be 15 years for the boiler and auxiliaries; 10 years for the radiation and piping.

Continued use of the existing system can result only in numerous shutdowns. One of the boilers might be used for peak loads, sketch above, if it's in good condition.

H B Swygert Jr — *Greenville, S. C.*

Unit heaters may be the solution

SJT's new building can be designed to simplify heating by proper insulation and choice of a heating system that fits both manufacturing needs and the building itself. Don't overlook the possibility of direct-fired gas unit heaters or steam unit heaters.

The old building is another problem. And its solution depends on an economic study of renovating the old system versus installation of a completely new heating system. Age alone is no basis for discarding a heating system. We operate a 32-year-old heating system, which will still be working efficiently at 40 years. Insulation of the building roof, attention to calking cracks around windows and doors, sand blasting the paint off old cast-iron radiators and internal radiator cleaning as well as routine maintenance can all add years of life to an old heating system.

The addition of a new boiler will boost efficiency and reduce maintenance enough to pay for itself in short order. But be sure to measure the steam and feedwater requirements accurately before deciding on boiler size. A few dollars invested in meters will pay off handsomely for finding both the right boiler size and, later, in keeping the boiler running efficiently.

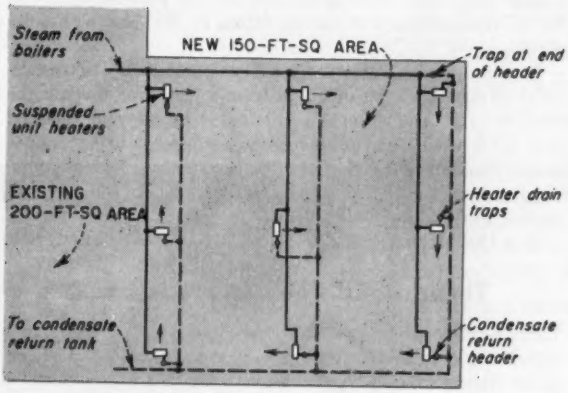
Fuel choice is a matter of economics. But be sure to include all costs: labor, investment, maintenance as well as fuel cost.

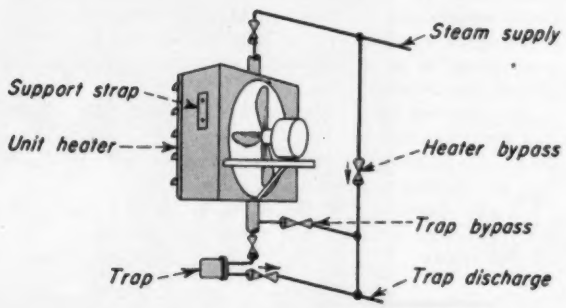
To insure a safe, dependable heating plant submit proposed installation drawings to your insurance company for their comment and approval.

H D Frye — *Vincennes, Indiana*

know-how put to work

HOWARD KALLEN, *Associate Editor*





Start with an economic study

Modernization of *SJT's* building heating system should begin with an economic study: Renovating and extending the existing system compared to replacing old boilers and installing a modern steam-distribution system.

The present boilers, after 30 years of service are probably operating at low efficiency. Result is high operating cost and maintenance expense. The added cost of new piping and heaters is a relatively small part of the total cost of the installation.

Two oil-fired steam generators should be bought to replace the present boilers. Each unit should have a maximum capacity equal to or slightly greater than maximum steam needs. Such units need little care. During inspection periods one boiler could operate at maximum load.

Building heating requirements should also be studied to find out which type of heater is most efficient for a particular area. Unit heaters conserve production space since they're suspended from above. Office heating is best done with radiators or convectors.

Here are advantages of unit heaters: (1) Their greater capacity means you can use fewer. (2) Room air is continually recirculated. (3) Supply- and return-line installation is simple. (4) Space can be heated up rapidly. (5) Heat output can be closely controlled.

Assuming a wall exists between present and new spaces, present area can be heated by suspending heaters as in the *top sketch, left.* Supply and return lines connect to three banks of heaters. *Lower sketch,* left, shows valving arrangement at a heater with a trap for discharging into the return header that connects to the condensate-return pump.

The usual method of heater control is to start and stop the fan manually through a switch. Steam and drain valves need not be closed when fan is stopped because heat output at this time is only about 5% of heater capacity. As areas at floor level become sufficiently warm, a unit fan can be stopped.

SJT should consult local and state codes during design stages. Various sections of the ASME standard codes are widely accepted and would cover boiler and piping work.

A J BREUGELMANS — *New York, N. Y.*

Want free consulting service? Send in your design and operating headaches to us. We'll give Power readers a whack at solving them.

Five modernizing tips

(1) Old steam piping may require resetting to eliminate possible sagging. (2) Piping should drain either toward the boiler or away from it, depending on length of run. (3) Drains should connect to traps that discharge into the condensate line. (4) Air traps on the steam piping should be tested and, if necessary, renewed. (5) Condensate piping should be checked for drainage toward the condensate tank. Dual control on tank is for pumping condensate to the boiler and maintaining vacuum in the tank and system.

J M GORRIE — *Euclid, Ohio*

Here's how I'd do it

First step in designing a heating installation: Find the heat loss. Then proportion and choose the heat-supplying equipment so it supplies the same amount of heat per hour. Figuring should be based on severest possible conditions.

Next, carefully evaluate building insulation costs against the heating plant's fixed charges and operating costs. Heat is lost through walls, windows, roof, infiltration. Also, it depends on building exposure.

The only systems *SJT* should consider are forced hot water and steam. The first cost of a hot-water system runs about 20% more than a comparable steam-heating system. Since hot water's main advantage—finer control—is not critical in most industrial buildings, I would stick with a steam system.

The system should be a low-pressure (less than 10 psig) 2-pipe vacuum-return type. Low pressure is best for unattended operation unless high-pressure steam is needed for a special process. Two-pipe design with individual traps assures right heat distribution.

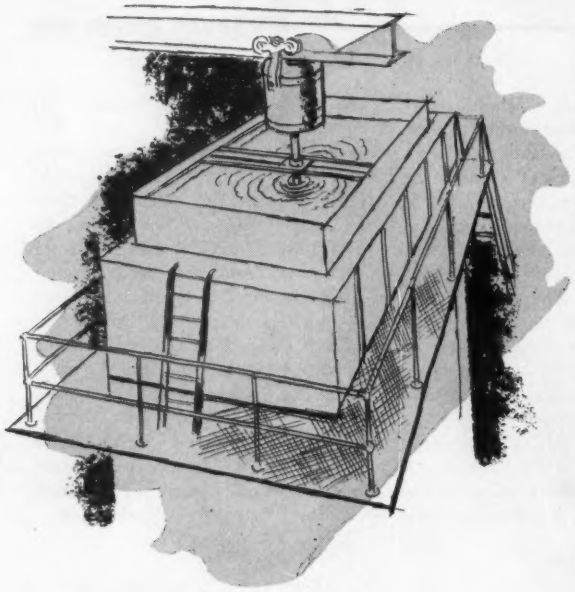
Install traps with a cooling leg and strainer. And take maximum advantage of gravity drainage.

J SCHNEIDER — *Needham. Mass.*

Turn page for info on electrical shock

More PLANT PROBLEMS

Begins on page 130



The question

What caused the shock in this chemical process?

Manufacturer of solutions for cleaning and polishing uses 115-230 volt single-phase current for lighting and 550-volt 3-phase current for power.

Chemical solutions are mixed in sheet-metal-lined wooden tanks surrounded by a wooden walkway with sheet-metal covering. Tank lining and walkway are not connected electrically or otherwise.

Foreman reports that a worker standing on the sheet-metal-covered walkway received a continuous shock when his finger was dipped into the tank solution. Shock power increased when the finger was further immersed. Tests of adjacent piping with a millivoltmeter didn't show any potential differences.

Tank solutions were agitated periodically by a motor-driven propeller carried over the tanks by a monorail. But motor tests didn't reveal a ground.

Condition was licked by electrically connecting the tank lining and walkway covering at four points. In addition, two connections were carried to the main water-supply pipe. Was the trouble caused by static? Would the problem have existed if a grounded neutral had been used on the 550-v distribution? What tests can be run to find cause?—*CVD, April Power*

The answers

Static electricity is the culprit

I believe the shock was caused by static electricity. The charge may have been generated during periodic agitation of the tank contents or during filling of the tank with solution.

I investigated a case where a metal tank was electrostatically charged by a jet of liquid from a feed pipe that hit the tank bottom. The static was eliminated by the same method that *CVD* used. We grounded the equipment using copper strip. Buildup of charge was demonstrated by using a simple homemade gold-leaf electroscope. I advise *CVD* to check for static buildup during filling or agitation.

R A LEUCHTER *Montreal, Canada*

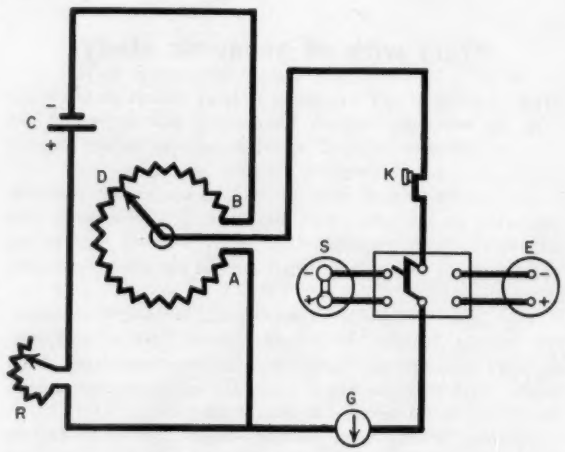
Three conditions caused shock

Three conditions contributed to the situation CVD describes: (1) The piping system is coated, internally, with some form of insulating film. (2) The piping system isn't electrically connected to the sheet-metal liner in the wooden tank. Corrosion would cause this trouble. (3) The chemical solution is acting as a ground return path for the neutral of the single-phase or as a high-resistance ground fault on the 550-volt 3-phase system.

The condition isn't the result of *mysterious* static causes. And grounding the 550-volt system wouldn't necessarily end the trouble unless by accident a ground path, more favorable than the existing one, were established.

It's also possible that the chemical solution was originally grounded and that the grating was *floating*.

J SCHNEIDER *Needham, Mass.*



Study electron flow to get answer

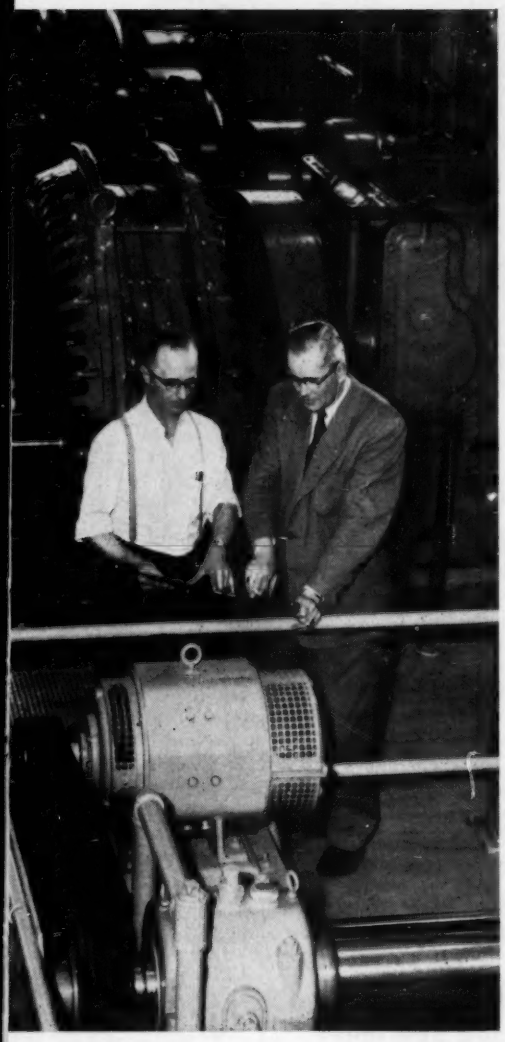
Contact between two different materials allows electrons to flow from one to the other at each contact point. The material receiving electrons becomes negatively charged. The other material becomes positively charged by losing electrons. Result is a voltage difference between the two.

In a salt solution (NaCl), sodium ions migrate to the negatively charged electrode while chlorine ions attach themselves to the positive electrode. When positive ions reach an electrode they pick up electrons. Negative ions lose electrons. The electron exchange completes an electrical circuit and ions are neutralized. Current depends on: number and type of ions in the solution, effective electrode

This utility gets better engine performance . . . less cylinder and ring wear with STANODIESEL Oil M

Report on Cumberland, Wisconsin, Municipal Utility's experience with diesel lubricants.

Piston from engine using STANODIESEL Oil M photographed just as it was pulled for 7,800 hour overhaul. Piston is clean and in excellent condition.



Clarence Maxcy (left), Chief Engineer at Cumberland, and Standard Oil lubrication specialist Ralph Rowlands check efficiency records of utility's engines lubricated with STANODIESEL Oil M. Providing technical service on lubrication problems is something for which Ralph Rowlands is well qualified. He has been doing this sort of work with Standard for 13 years. Ralph attended the University of Wisconsin and is a graduate of the Standard Oil Sales Engineering School.

Management of Cumberland, Wisconsin, Municipal Utility found a way to extend time between ring changes, to get greater fuel efficiency and to cut cylinder wear. How? By using STANODIESEL Oil M.

Before converting to STANODIESEL Oil M, the utility found it necessary to change rings every 1,500 to 2,500 hours. Cylinder wear ranged up to .003" per 1,000 hours of operation. After the engine was converted to STANODIESEL Oil M, it was run 7,800 hours at 50 to 90 per cent of full load. No rings had to be replaced during that time. The engine was then overhauled. All rings were free. All pistons were clean and in excellent condition. Ring wear was apparent on the two top rings only, bottom rings were like new. Cylinder wear after 7,800 hours averaged .003". This amount of wear occurred after 1,000 hours with the oil formerly used. On some cylinders, wear was only .001". Maximum bearing wear was .0005". Fuel efficiency over the period averaged 12.93 K.W.H. per gallon.

This kind of performance—reduced wear, increased fuel efficiency, improved overall engine performance—is what you can expect from STANODIESEL Oil M. Find out more. Call your nearby Standard Oil lubrication specialist. There is one near you in any of the 15 Midwest and Rocky Mountain states. Or write, Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY
(Indiana)

STANDARD

Quick Facts About
STANODIESEL Oil M

- Is refined from highest quality base stock. Has superior stability.
- Contains special additives that:
  - Inhibit oxidation, control unwanted increases in oil viscosity.
  - Keep crankcase, pistons, cylinder walls and other parts clean.
  - Keep contaminants in suspension, prevent them from depositing.
  - Control foam, make oil suitable for use in hydraulic governors.
  - Increase the oil's ability to reach and maintain a film on highly stressed parts.

Begins on page 130

area, distance between electrodes, potential difference between electrodes and solution temperature.

Static electricity can be generated from a dielectric fluid flowing in a pipe or vessel. Typical fluids are: gasoline, kerosene and fuel oil. Many other fluids that have dielectric properties will generate static electricity when flowing and making contact with the surfaces of metal pipes, tanks, hose lines, glass and plastic piping.

System and equipment grounds and conductor-enclosure grounds are available for interior wiring systems. By installing such grounds, any metallic parts that operators touch are at or near ground potential, thus avoiding or minimizing shock.

Metal conduit, raceways and boxes may contact metal parts of a building at several points. If an accidental contact takes place between an ungrounded conductor and its metal enclosure, a current may flow to ground through a stray path made of piping, structural beams, columns, platforms and other construction materials. With equipment grounded, resistance of the path through the grounding conductor is usually less than resistance of the stray path, thus limiting current flow in the stray path.

In a wet area, all non-current-carrying parts of electrical equipment should be grounded. Grounding also applies if equipment is within reach of operators who are standing on the ground or who might contact a ground surface.

Since the electrical shocks *CVD* talks about resulted from a potential caused by immersing a finger in the solution, I suggest he use a potentiometer to find source of the current. The potentiometer compares potential of the chemical solution with that of a standard cell. If two equal and opposing voltages are in the circuit, no current flows.

The sketch, p 132, shows the components needed for the potentiometer test. First, impress a known voltage across resistance *AB*. The sliding contact *D*, moves along this resistance. Ratio of *AD* to *AB* measures fraction of the known potential that's picked off to oppose the chemical solution's potential, cell *E*. Working cell *C* furnishes an opposing voltage connected through adjustable resistance *R* to the terminals of uniform resistance *AB*. *AB* is divided into ten or more equal parts and has a resistance scale on it. Fine divisions permit adjusting the potential drop opposing *E* to .0001 volts.

In operation, the double-throw switch is first connected to the standard cells (usually 1.0186 volts). The sliding contact is rotated to read 1.0186. The key *K* is tapped intermittently while adjusting *R* until galvanometer *G* reads zero. Next, the switch is thrown to connect the potentiometer to cell *E*. Contact *D* is again rotated to a position so *G* shows no deflection when tapping the key *K*. The potentiometer then reads voltage of cell *E*.

This instrument can read very small voltages, providing the operator with quick, reliable detection.

H B Wayne — *Brooklyn, N. Y.*

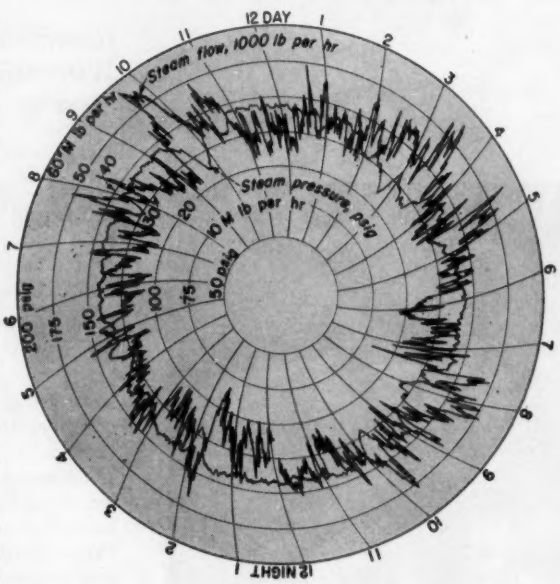
Try bonding or grounding

Trouble *CVD* describes is probably caused by stirring or natural circulation of the fluids, resulting in static.

Bonding or grounding is the right way to correct the condition. It's always a good idea to ground such equipment if there's a possibility of static electricity being generated. A spark resulting from static elctricity may be discharged any time a closed circuit is formed, causing a fire or even an explosion if conditions are right for it.

C G Howarter — *Canton, Ill.*

Your July Problems



1 How can we control steam distribution?

My boiler plant is equipped with one 30,000-lb-per-hr watertube boiler and four hrt 84-inch firetube boilers. We sell process steam to a dye house as well as to other companies.

Normal main steam pressure is 140 psig. An 8-inch line feeds the dye house. Their load, shown on the chart above, goes suddenly from 15,000 to 50,000 lb per hr, causing main steam pressure to drop considerably. We aren't worrying about pressure drop in the dye-house operation, but do care about it for another company that we supply. They must have a constant steam pressure of 140 psig.

To rectify the condition, I'm considering installing an orifice or reducing section in the supply line to the dye house, to limit flow to 30,000 lb per hr. Will this solve my trouble? Are there better ways to do the job? I'd like *Power* readers' opinions.—*JLC*

2 What's best way to cool fan bearings?

For some time I have heard arguments on just how much cooling water should be kept on fan bearings, but have never come up with an answer that really satisfied me. Our fan shafts are 6-inch diameter. We have 18-inch bearings with two ½-inch water lines to keep the bearing cool.

Some operators like to keep water gushing out the drains, while others prefer the pencil-size stream. I'd like to know which method is best?—*JWB*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.

WHERE SAFETY IS NO ACCIDENT

The confidence of engineers in FLEXITALLIC Spiral-Wound Gaskets is based on performance. Flexitallic has justified that confidence for more than 40 years by:

—a continual search for new and better gasket materials

—maintaining standards of engineering and design that give complete assurance of a work-proved seal

—making of gaskets on precision winding machines designed by our own engineers.

In nearly every industry, engineers look to Flexitallic for leadership in safety. As the service becomes more hazardous — in aviation, atomic research, power plants, process industries, and aboard ship—the need for Flexitallic Gaskets becomes more urgent.

Each Flexitallic Gasket is designed and engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285".

FLEXITALLIC GASKET CO.
8th & Bailey Sts., Camden 1, N. J.
Representatives in principal cities

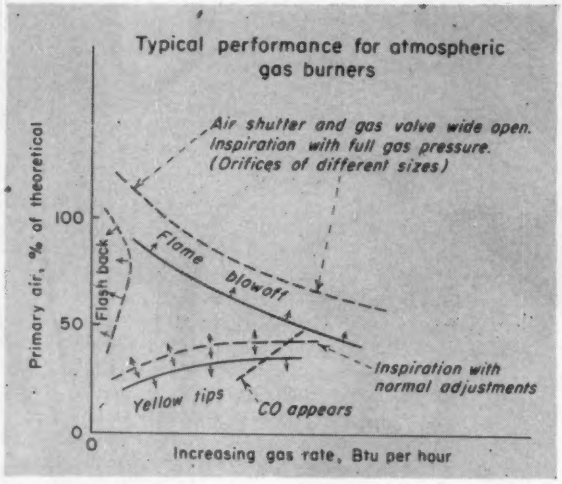
Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered trade name. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue*—it's our exclusive blue-dyed Canadian asbestos filler.

ARGUMENTS . . . *it pays to pop your safeties here*

ALTHEA THORNTON, *Assistant Editor*



Why we ground generator neutrals

1. Avoid inconvenience, damage from multiple faults that may result when single ground faults are not cleared promptly on an ungrounded system.

2. Detecting and locating ground faults on ungrounded systems cost money. If generators are neutral-grounded, fault literally smokes out the location.

3. Neutral grounding prevents transient overvoltages that may puncture motor insulation.

4. Voltage on unfaulted phases will be held in check during ground faults if neutral is properly grounded.

5. Lightning arresters are less expensive, more effective, on grounded-neutral systems.

6. Above 5 kv, neutral grounding permits you to employ less costly cable.

Gas-oil combinations are OK

Back in January POWER, L V Andrews discussed the problem of burning gas and oil in combination. He said when burning gas from a gas gun simultaneously with a center-fired oil gun, you obtain poor results compared with those when either fuel is burned alone. His explanation is that gas tends to blanket the spray leaving the oil gun, and does not let the air contact the oil spray at the required location.

Andrews further states that gas can be burned from an annular gas ring in combination with a centrally fired oil gun without combustion troubles because in this case air stream is in a layer between the two fuels.

Available burners can fire gas and oil independently or in combination, according to my information. When burning two fuels concurrently, a burner correctly designed for this type of firing should be satisfactory.

Using the gas as an atomizing medium gives the required turbulence and mixing. Alternate schemes allow mixing gas and atomizing air as they enter the burner, or inserting an aspirator and mixing in burner's main air line. Choice of method depends on available gas pressure and required control characteristics.

Sketch above shows typical performance for atmospheric gas burners. It relates primary air and gas firing rate with burner performance. Similar characteristics apply for oil and combination units. These data can be obtained from the burner manufacturer and should be consulted to determine the limits of stable operation.

H B WAYNE *Brooklyn, N. Y.*

Best way to blow waterwalls?

Most modern boilers with watercooled furnaces have a high heat-transfer rate. This does not allow blowing down waterwall headers so these valves are not normally operated.

When taking a unit off the line, pull fires, then give waterwall valves a good blow. If they are plugged, it can be a hard job to clean them after pressure is off the boiler.

JAMES MUNRO *Port Mellon, B. C.*

My feelings on grounding neutrals

The reasons for grounding generator neutrals listed above were presented by Ben Smith in November POWER, p 24. After mulling them over, I want to comment.

No. 2. It's not difficult or costly to find faults on an ungrounded system. A sensitive type of ground detector indicates a fault condition at once. Fault location in a particular feeder or circuit or in the generator itself can be readily determined at light load by momentarily opening circuits. A tracer current is superimposed on the system. Detector is moved along the particular circuit leading you right to the fault point (see *Today's Electrical Practice*, POWER, Oct. 1953, p 92).

No. 3. Few operators of ungrounded systems realize the unstable situation and fluctuation of line-ground voltages in these systems. There are wide variations depending on insulation conditions in the whole system. It is not uncommon to find by test that there is full voltage between two conductors and ground while the third is nearly zero.

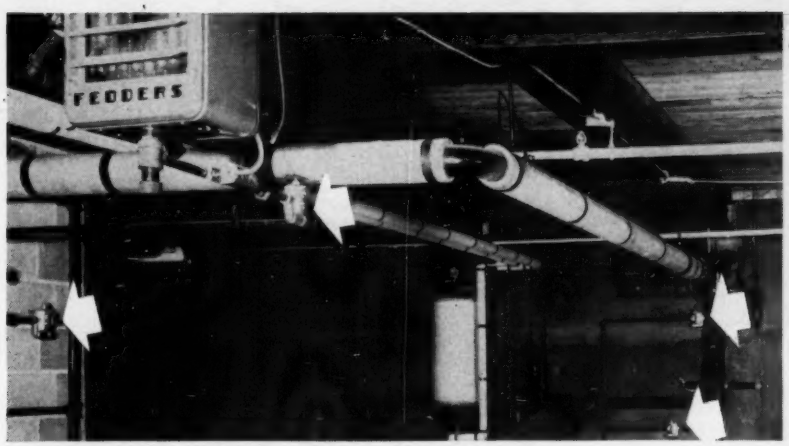
The average operator does not realize that with even a single ground fault on an extensive ungrounded system the inevitable charging (capacity) current must flow. Insulation charring becomes progressively worse so a positive line-to-line fault does far more damage than would be possible in a grounded neutral system.

Some men contend that an ungrounded system can be operated for any length of time with one grounded conductor. This is an unsafe assumption if the system is at all extensive. And with a generator fault the damage may result in an actual shutdown.

No. 4. Troubles have developed on extensive ungrounded industrial installations operating at a nominal 575 volts line to line, or 332 volts line to ground. With 2300 volts line to line or 1330 volts line to ground charring troubles become much more severe. It is much less trouble to keep a grounded neutral system in operating condition than to correct conditions that may occur with an ungrounded system.

C O VON DANNENBERG *Brooklyn, N. Y.*

How One Company Has Saved $80,000 to Date by Buying 600 Steam Traps



Armstrong built-in strainer traps save maintenance as well as fuel at L. G. Balfour Co., Attleboro, Mass.

Joseph Brooks, Production Manager at Balfour, insists on "Armstrongs — *no substitute.*"

Armstrong Traps on Low Pressure, Vacuum Return Heating System Cut Fuel Costs $8,000 Per Year, Have Served 10 Years Without Repairs

YOU'D HAVE TO SELL a lot of fraternity pins to come out with $80,000 profit. But, that's the dollar-saving a couple of alert plant men have made by installing Armstrong steam traps at L. G. Balfour Company, fraternity jewelry makers of Attleboro, Mass. And, they've made their own jobs easier by doing it.

Just 10 years ago, Joseph Brooks, Production Manager, and C. J. Ripley, Maintenance Superintendent, installed the first Armstrong traps on their low pressure vacuum return heating system. Now they have 600 in use throughout the plant. The results have been an engineer's dream:

1. Fuel costs reduced $8,000 annually despite doubling of the factory's size and increased prices of coal.

2. One boiler did work of two after trap installation in original plant. Steam pressure was reduced from 50-75 lbs. to 22-27 lbs. Pressure is reduced to 4 lbs., with 6"-8" vacuum.

3. No trap repairs except cleaning in 10 years and no servicing of any kind where strainers were used ahead of traps. Armstrong Y-Type strainers have now been installed ahead of all No. 800 traps and all new traps are No. 880's with built-in strainer (costing less to buy and install than separate strainer and trap.)

This story of Balfour's $80,000 profit wouldn't be as significant if it were the only one of its kind. But, the frequency of such reports about Armstrong trapping establishes firmly the tremendous cost-reduction opportunities available to many plants throughout the country — perhaps to yours. Isn't it worth looking into?

Your local Armstrong Factory Representative or Distributor will survey your trapping without charge or obligation. Call him or write:

Bottom inlet and side inlet styles for all services.

FREE:
44-page Steam Trap Book —a complete guide to better trapping

ARMSTRONG MACHINE WORKS
812 Maple Street, Three Rivers, Michigan

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Michigan

Please send me a "Steam Trap Book"

Name_____

Company_____

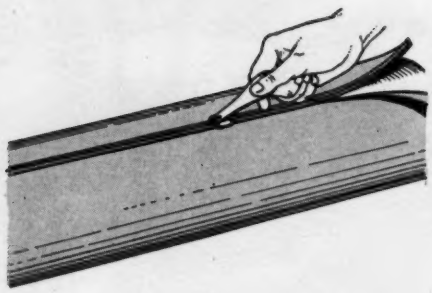
Street Address_____

City_____ Zone____ State_____

1 Vinyl tape of 2-in. width is wrapped around insulated fitting on the line in preparing it for a watertight joint

2 Covering is placed around insulation on straight section of line. Zip-on feature is claimed to make it watertight

3 To seal the joints and laps of taped section with section sealed with sheet covering, apply the sealing compound



HOW TO

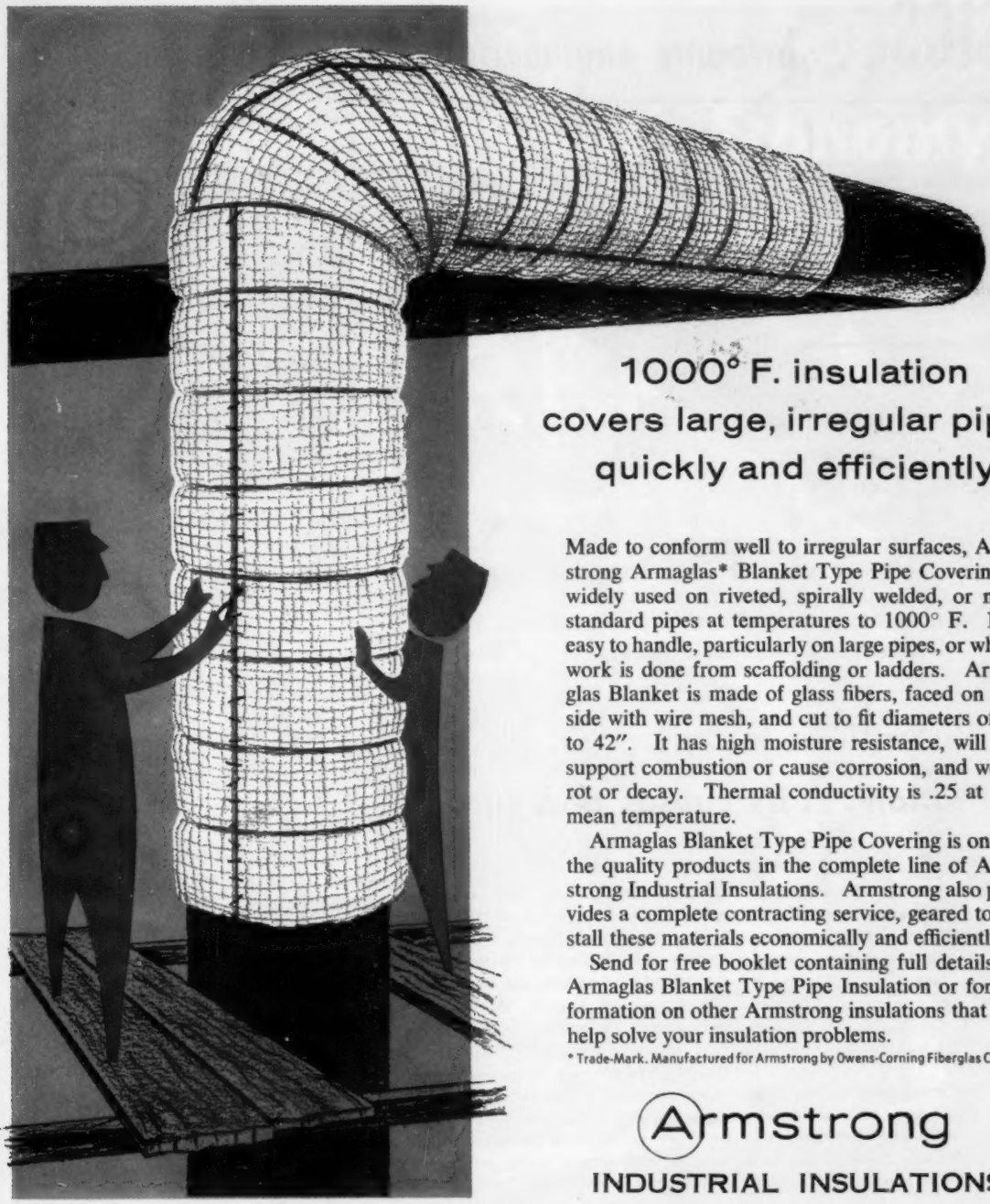
zip on pipe covering

► A PREFABRICATED specially compounded polyvinyl chloride-acetate pipe-covering finish is now on the market. For temperatures of –60 to 200 F, it's designed to protect insulation against weather, abrasion, chemicals, mildew, etc.

This finish is furnished to exact size, zips on the insulation and locks in place with its integral all-polyvinyl closure. Claim is a watertight and airtight longitudinal joint. Zipper does away with cutting, fitting or sewing in the field.

Material also comes in colors, so no painting or refinishing is needed. Oil, rust or dirt are removed with a damp cloth. Manufacturer recommends it for indoors, outdoors, underground.

Courtesy, Miracle Adhesive Corp, New York, N. Y.



1000° F. insulation covers large, irregular pipes quickly and efficiently

Made to conform well to irregular surfaces, Armstrong Armaglas* Blanket Type Pipe Covering is widely used on riveted, spirally welded, or non-standard pipes at temperatures to 1000° F. It is easy to handle, particularly on large pipes, or where work is done from scaffolding or ladders. Armaglas Blanket is made of glass fibers, faced on one side with wire mesh, and cut to fit diameters of 3″ to 42″. It has high moisture resistance, will not support combustion or cause corrosion, and won't rot or decay. Thermal conductivity is .25 at 75° mean temperature.

Armaglas Blanket Type Pipe Covering is one of the quality products in the complete line of Armstrong Industrial Insulations. Armstrong also provides a complete contracting service, geared to install these materials economically and efficiently.

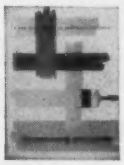
Send for free booklet containing full details on Armaglas Blanket Type Pipe Insulation or for information on other Armstrong insulations that can help solve your insulation problems.

* Trade-Mark. Manufactured for Armstrong by Owens-Corning Fiberglas Corp.

Armstrong

INDUSTRIAL INSULATIONS

☐ Armstrong Armaglas Insulations for Pipes, Tanks, and Vessels



☐ Armstrong Insulcolor®, Weatherproof Coating in Eight Colors

☐ Armstrong Armatemp* Blocks, Blankets, and Cements

*TRADE-MARK

☐ Armstrong LT Cork Covering, a New Type Cold Line Insulation

Armstrong Cork Company
2007 Riggs Ave.
Lancaster, Penna.

Please send me the free booklets checked. ☐

Please have an Armstrong representative call. ☐

Name .....

Position .....

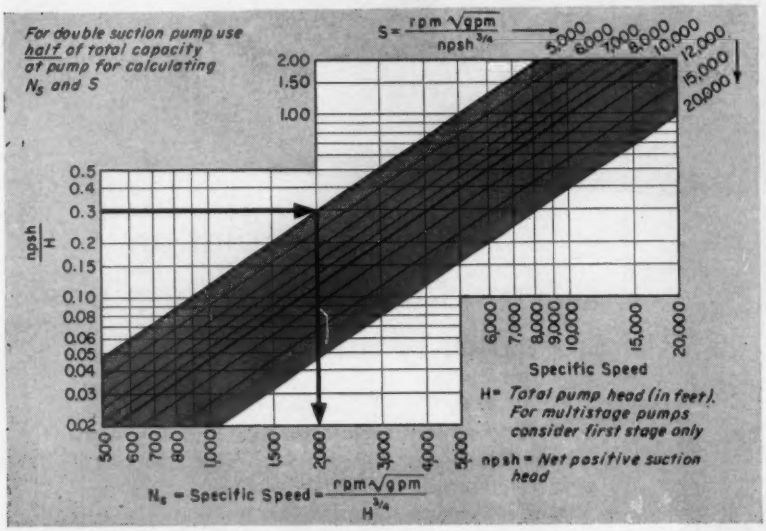
Company .....

Address .....

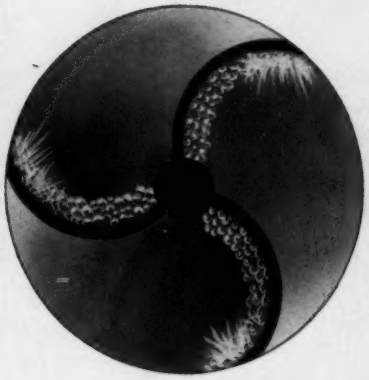
City ..... Zone .... State .....

BASICS . . . *bringing engineering theory down to earth*

HOWARD KALLEN, *Associate Editor*



CAVITATION LIMITS of centrifugal pumps. Figure npsh/*H* then find N_s



VAPOR CAVITIES form at impeller inlet, break near edge because of pressure

FLUID FACTS — 11

Cavitation . . . its causes and cures

► IF YOU'RE RESPONSIBLE for selecting, installing or operating centrifugal pumps, you've probably seen impellers that look as though they've been gouged out near their outer edges. Maybe it's happened in your own plant. Chances are cavitation is the culprit. To lick the problem you need to know what causes it, common cures.

Pump suction conditions are the key to whether you'll run into cavitation problems. So let's see what happens to liquid as it flows through suction piping and into the pump. If open tank of liquid is above the pump center line, force of gravity and atmospheric pressure push liquid through the pump. If supply is a pressurized tank, pressure acting on liquid surface provides additional force.

But on many jobs, the pump must lift water from a source that's below its center line (suction lift). Under such conditions, atmospheric or other pressure on liquid surface must not only supply the force needed to push liquid into the pump, but must also overcome gravity.

In operation, the rotating impeller reduces pressure at the suction pipe, creating a partial vacuum at pump inlet. Boosting impeller's rotational speed reduces pressure at the pump inlet even more. Result: Liquid on suction side, taking the path of least resistance, rushes into the pump inlet.

Kept within bounds this pressure reduction is a necessary and useful part of pump operation. But sometimes pressure can drop to liquid's vapor pressure. (This pressure is nothing more than a measure of the liquid's tendency to vaporize at any temperature. For instance, vapor pressure of 60-F water is only 0.26 psia. But increased energy of water molecules at 212 F boosts vapor pressure to atmospheric—14.7 psia.) When local pressure at the impeller dips to vapor pressure, vapor cavities form on concave side of the impeller vane. As liquid moves out toward the vane tip, its pressure increases, breaking vapor cavities with hammerlike force. Collapsing force is great enough to break off small pieces of the impeller, cause pitting.

To avoid cavitation, operate pump at a net positive suction head (npsh) equal to or greater than the manufacturer's recommended minimum.

Here's how you figure npsh:

$$npsh = p_a + p_s - p_f - p_v$$ where

p_a = pressure at surface of liquid supply, ft

p_s = elevation of liquid supply above pump center line, ft

p_f = friction pressure drop in suction line, ft

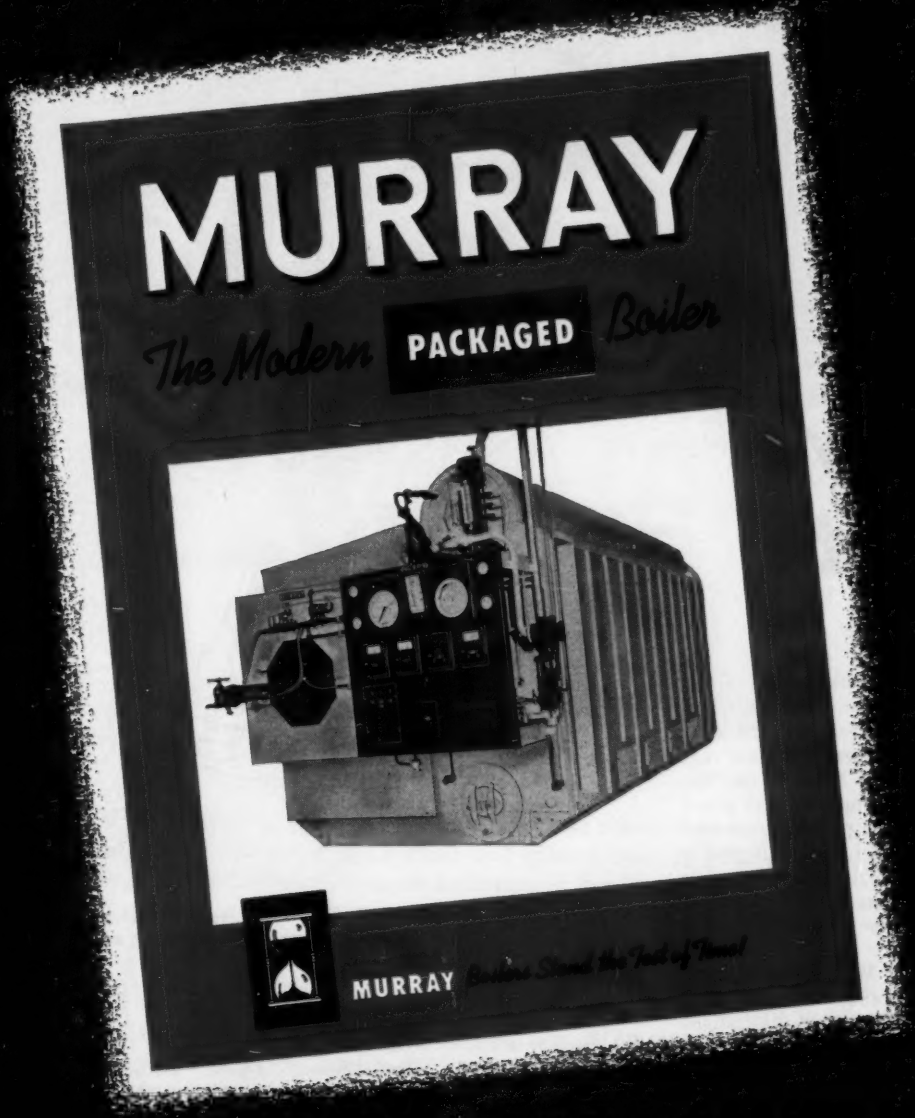
p_v = vapor pressure, ft

Divide npsh by head the pump actually produces to get what pump designers call *cavitation constant.* Graph, top at left, ties cavitation constant to pump's *specific speed.* (Specific speed is an index of pump type. High-head pumps have low specific speed; low-head pumps have high specific speed. Numerically, it's the rpm at which the impeller would run if reduced in size to deliver 1 gpm against 1-ft total head.) Once you've figured the cavitation constant, you can use the graph to find pump's safe specific speed. For any cavitation constant, conservative design calls for choosing lower specific-speed values.

Suction specific speed S, also shown on the graph, is an index much like specific speed except that it substitutes npsh for total pump head. To avoid cavitation under any set of operating conditions (gpm and head), the pump's actual speed should be such that, when you substitute it in the formula for specific speed, result is less than or equal to pump's specific speed.

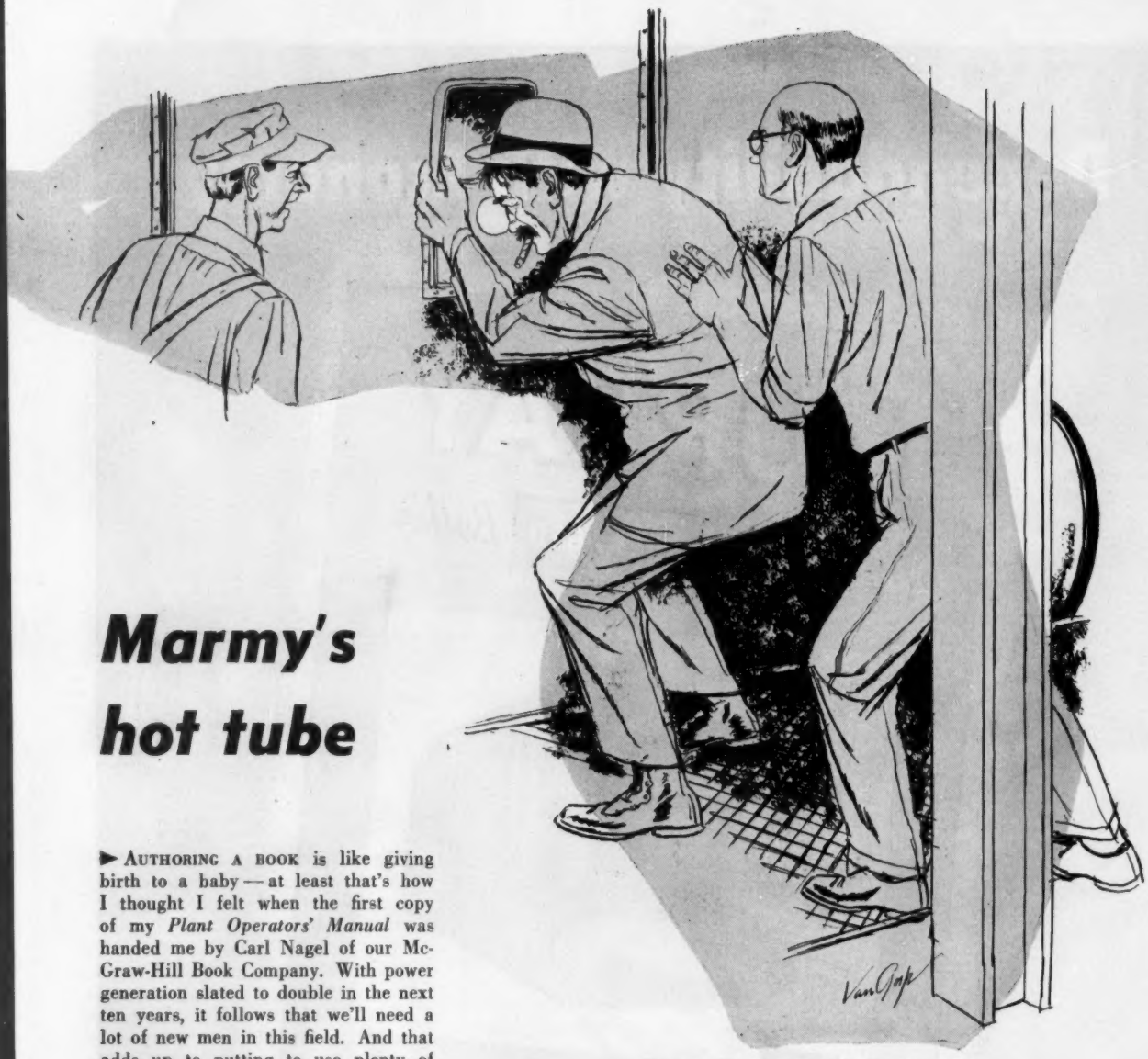
With this installment, we wind up the Basic Series on Fluid Facts. Next month, Assistant Editor Norm Peach takes over with a series on Electrical basics. First chapter: Current flow.

Dependability with Economy!



MURRAY packaged boilers are designed to meet today's need for compact, low cost, reliable heating and generating plants . . . When you install a MURRAY packaged boiler, you get the benefit of over 85 year's experience exclusively in the manufacture of boilers and allied products . . . . Write for new folder, "MURRAY, The Modern Packaged Boiler," which gives complete information.

MURRAY IRON WORKS COMPANY · BURLINGTON, IOWA



Marmy's hot tube

Marmy squinted a weather eye and peeked into the boiler's peephole before popping off

► AUTHORING A BOOK is like giving birth to a baby — at least that's how I thought I felt when the first copy of my *Plant Operators' Manual* was handed me by Carl Nagel of our McGraw-Hill Book Company. With power generation slated to double in the next ten years, it follows that we'll need a lot of new men in this field. And that adds up to putting to use plenty of know-how that some of us have learned the hard way.

"Wonder what Marmaduke Surfaceblow will think about this book?" I asked myself. "With 1539 illustrations to show everything from setting piston valves to charging a new refrigeration system, the *Plant Operators' Manual* should impress the old boy."

Tucking a copy of the *Manual* under my arm, I headed for the old consulting engineer's beat-up office above O'Houlihan's Machine Shop & Engine Works. Climbing the stairs, I heard a lot of noisy chatter that told me he was in, along with his usual shipmates.

Yup, the crafty consultant was at his roll-top desk, busily sketching a piping diagram and puffing away at a cigar butt. The ship's settee along the wall was held down by a half dozen of his cronies, who were fighting the first World War. The argument seemed to be about the daily coal consumption of the battleship *USS Oregon* back in 1919. And, as usual, the winner seemed to be a character who talked loudest.

I took a few deep breaths of air, then barged bravely into that smoke-filled room. After my eyes stopped smarting and my Adam's apple quieted down from violent coughing, I placed my book on Marmy's desk and tried to make myself heard above the noise.

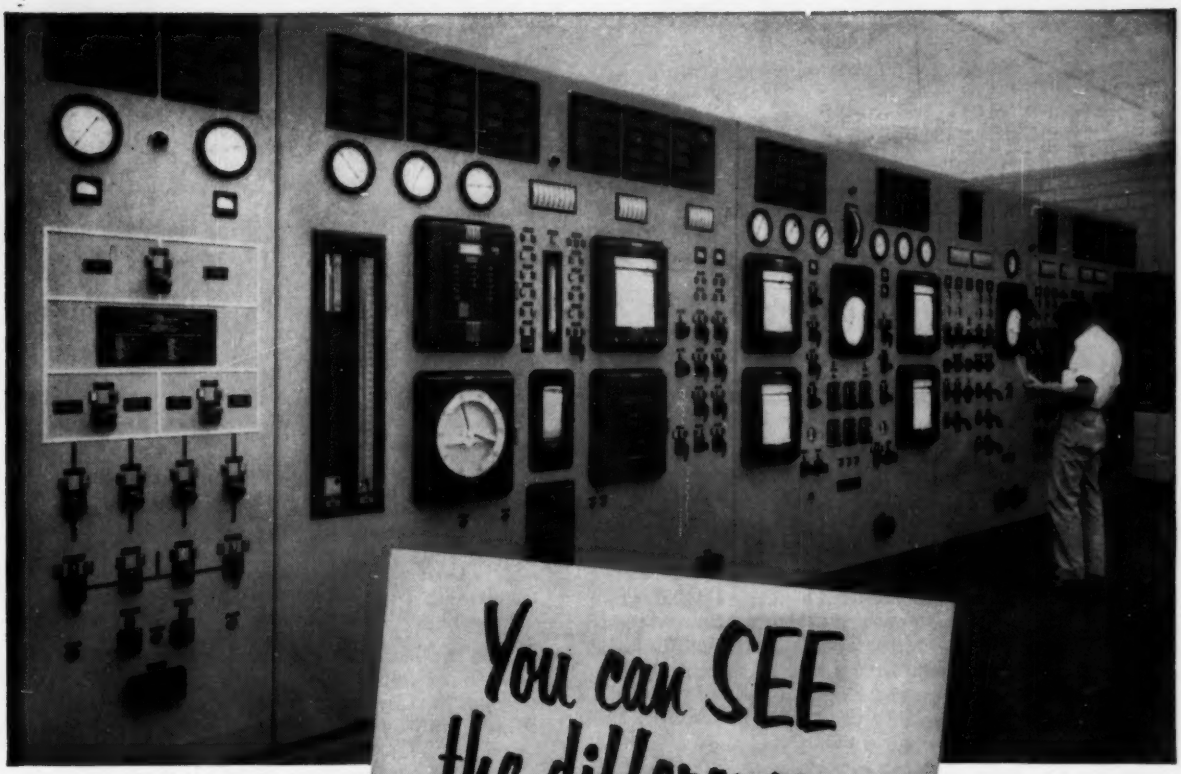
"This should help a lot of plant personnel from firemen up to plant engineers, Mr Surfaceblow," I shouted above the racket.

Marmy stopped sketching, then focused his ancient running lights on the book for a second, puffing furiously at his rope yarn as if deep in thought. Suddenly he removed his silver-rimmed specs and roared, "Bilgewater on boning up for an operator's license, cramming for an exam or studying for a degree! I'll tell you about the time I solved a mysterious hot-tube problem, and I didn't use a book. All I did was shut off a burner."

That blast stopped the works. The characters on the settee put a muffler on their wrangling and started slurping coffee. Marmy leaned back in his swivel chair, hoisted his size-16 canal boats to his roll-top desk, and gave his gray bowler the usual starboard list. I sat down in a corner near the window where I could breathe something besides monoxide gas and unburned tobacco carbon.

"Back in 1934," started Marmy, blasting away in his foghorn voice, "I was Chief Engineer on the tanker *SS*

(*Continued on page* 182)



L+N complete panels serve the needs of your operating personnel. Each panel is designed and custom-built to your requirements. Instruments and controls are arranged in a functional pattern for easy reading . . . assist in reducing fuel costs and operating errors.

L+N complete panels save time and costs for your panel installation. We completely assemble each panel in our plant, with all instruments in place, double-checked and tested. You receive panels ready to go when connected to primary elements and control devices.

L+N complete panels solve your panel engineering and design problems. Our panel engineers convert your requirements for control of boiler, turbine and auxiliary equipment into a functional layout for your approval. From this layout we prepare the electrical and piping diagrams and the final steelwork drawings. You receive prints of these drawings as part of our standard panel engineering service.

***Let an L&N panel engineer** study your problems; he'll explain in detail what we can do for your particular plant. Our fifteen years in building panels for many utilities assures you of* effective service. *Write to Leeds & Northrup Company, 4910 Stenton Avenue, Philadelphia 44, Pa.*

LEEDS NORTHRUP
instruments automatic controls • furnaces

JENKINS PRACTICAL PIPING LAYOUTS

77

How to plan piping connections for

ALL-YEAR AIR CONDITIONING WITH THE HEAT PUMP

The heat pump principle is now used extensively for year-round air conditioning. This type of system is of greatest interest to builders in areas where a low power rate is available, or where the heating load is approximately equal to the cooling load.

Well water is used as the thermal source in the heat pump installation illustrated. The major components of the system are the well pumps, a water chiller (evaporator), a water heater (condenser), and a multizone air conditioning unit. Such a system could readily serve a building with several exterior and interior zones, which would have many air handling units. For simplicity, only one unit is shown in the diagram.

For heating demands, this system provides a closed circuit consisting of hot water pump, condenser, and heating coil. For cooling, a second closed circuit consists of chilled water pump, evaporator, and cooling coil.

During the heating season, water is supplied to the settling tank from the warm water well (about 60° F). It is circulated by the chilled water pump to the evaporator, and then to the cooling coil to provide cooling, where needed, for interior areas. The water then flows to the recovery coil, picks up heat from waste air and carries it to the preconditioning coil, where it is used to preheat outside air. The resulting chilled water is discharged to the cold water well.

During the intermediate seasons, water is supplied to the settling tank from the cold water well (about 50° F). It is circulated by the hot water pump to the condenser, and then to the heating coil to provide heat, where needed, for the exterior zones. The water is then discharged to the hot water well.

During the cooling season, water from the cold water well is pumped to the settling tank, and then circulated to the evaporator and the cooling coils. It is next used to cool the condenser, and is then discharged to the hot water well. If the demand for cooling is low, and the well water cold enough, the evaporator may be bypassed.

Jenkins Fig. 368 Bronze Gate Valve is recommended for many of the shutoff and control services in this layout. The position of the rising spindle indicates at a glance if the valve is open or closed. The solid wedge affords maximum resistance to pressure strains. Outside threads allow easy cleaning and lubrication.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17.

Fig. 368
BRONZE
GATE VALVE
Solid Wedge
O.S. & Y.
Rising Spindle
125 psi.
Saturated Steam
200 psi. O.W.G.

SEND FOR THIS FOLDER. It illustrates and describes the complete line of Jenkins Bronze Gate Valves, which includes 40 different patterns for various service conditions. Contains handy chart for quick reference. Fill out and mail coupon today.

JENKINS BROS.
100 Park Ave.,
New York 17, N. Y.

Please send
Bronze Gate Folder-Form 181-C

Name.....

Company.....

Address.....

.....

ALL-YEAR AIR CONDITIONING WITH THE HEAT PUMP

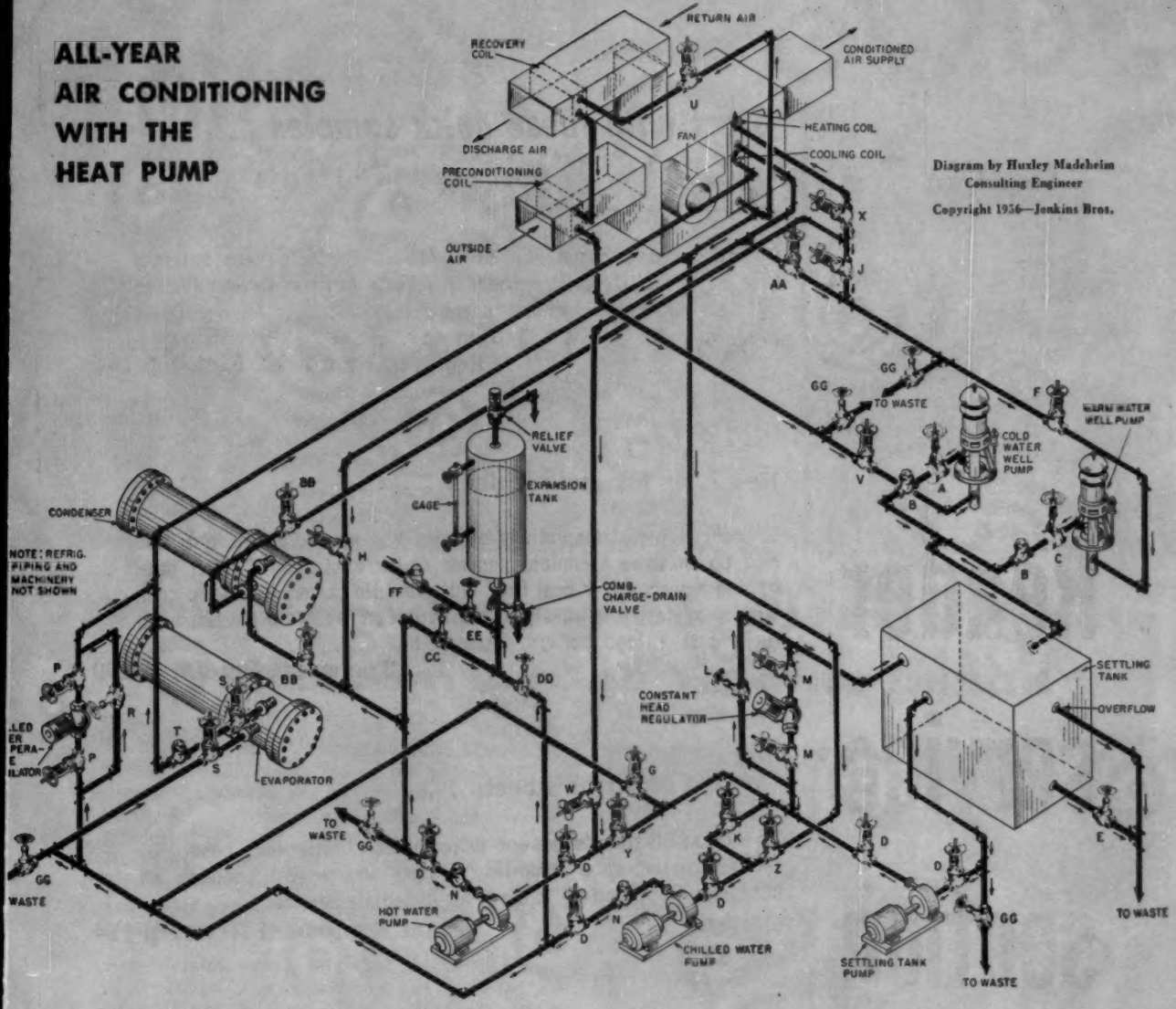


Diagram by Huxley Madeheim
Consulting Engineer

Copyright 1956—Jenkins Bros.

Code	Quan.	Jenkins Valve	Service
A	1	Fig. 677A Br. Gate	Cold water well shutoff valve
B	2	Fig. 295 Br. Sw. Check	Prevent backflow thru well pumps
C	1	Fig. 677A Br. Gate	Warm water well shutoff valve
D	6	Fig. 368 Br. Gate	Circ. pump shutoff valves
E	1	Fig. 106A Br. Globe	Settling Tank drain valve
F	1	Fig. 368 Br. Gate	Shutoff discharge to warm water well
G	1	Fig. 368 Br. Gate	Control water to evaporator
H	1	Fig. 368 Br. Gate	Control water to condenser
J	1	Fig. 368 Br. Gate	Control water to warm water well
K	1	Fig. 368 Br. Gate	Control water to ch. water pump
L	1	Fig. 106A Br. Globe	Constant head regulator bypass
M	2	Fig. 368 Br. Gate	Constant head regulator shutoff
N	2	Fig. 352 Br. Sw. Ch.	Prevent backflow thru circ. pumps
P	2	Fig. 368 Br. Gate	Ch. water temp. regulator shutoff
R	1	Fig. 106A Br. Globe	Ch. water temp. regulator bypass

Code	Quan.	Jenkins Valve	Service
S	2	Fig. 368 Br. Gate	Evaporator shutoff
T	1	Fig. 352 Br. Sw. Check	Prevent backflow thru evaporator
U	1	Fig. 368 Br. Gate	Shutoff water to recovery & precon coil
V	1	Fig. 368 Br. Gate	Shutoff discharge to cold water well
W	1	Fig. 368 Br. Gate	Control water to hot water pump
X	1	Fig. 368 Br. Gate	Shutoff water to heating coil
Y	1	Fig. 368 Br. Gate	Control water to hot water pump
Z	1	Fig. 368 Br. Gate	Control water to ch. water pump
AA	1	Fig. 368 Br. Gate	Control water to warm water well
BB	2	Fig. 368 Br. Gate	Condenser shutoff
CC	1	Fig. 47 Br. Gate	Expansion tank shutoff valve
DD	1	Fig. 47 Br. Gate	Expansion tank shutoff valve
EE	1	Fig. 47 Br. Gate	Control makeup to expansion tank
FF	1	Fig. 92 Br. Sw. Check	Prevent backflow to water lines
GG	5	Fig. 106A Br. Globe	Drain valves

VALVE RECOMMENDATIONS

For details of valves to suit varying conditions see Jenkins Catalog.

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

SINCE 1864 TRADE JENKINS MARK

SOLD THROUGH PLUMBING-HEATING AND INDUSTRIAL DISTRIBUTORS

Jenkins Bros

Reader service section

Start with these quick samples . . .

Atomic-age landmark . . .

Operations have begun at B&W's Atomic Products Plant—nation's first major facility built entirely at private expense to manufacture and test nuclear fuel elements and related products for peacetime use. Want the full facts? Turn to . . .

Reports From the Field, p 148

New uses for gas turbines . . .

in process industries, utility systems and naval vessels are summed up in three technical papers. Quick abstracts of other gas-turbine reports cover coal-fired units, mobile power, increased combustion-system life. And you'll find digests on hydro development, fuels and firing, boilers, pumps, in . . .

Technical Briefs, p 150

Cooling tower on wheels . . .

is one manufacturer's answer to production bottlenecks caused by limited cooling-water supplies. Unique arrangement contains all necessary accessories, is ready for immediate service.

Plant Equipment News, p 154

Power take-offs . . .

for i-c engines to 600 hp get the full treatment in this month's lead bulletin. There are 30 items in all, covering most phases of the power field. Indicate the ones you want, stamp and mail the handy post cards provided—we'll do the rest.

Free Literature, p 163

Dreams can come true . . .

especially when a wife teams with her husband to strive for these dreams. But there's a big difference between ambition and wishful thinking. Success and the role played by the distaff side in obtaining success are presented in this month's . . .

George Edwards, p 166

For other timely ideas, see following service pages ▶

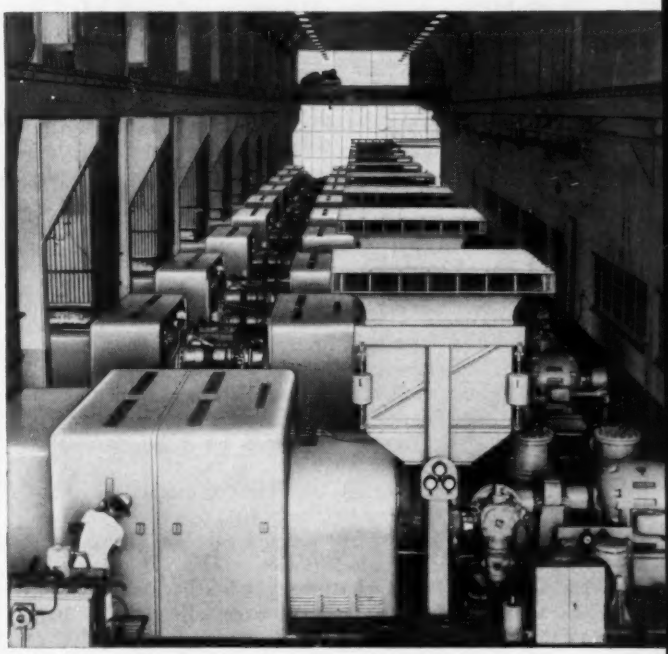
GAS TURBINE
OPERATING REPORT

Why General Electric is proud of Creole Petroleum's "Gas Turbine Island"

Seven miles out in Venezuela's Lake Maracaibo stands a unique example of the petroleum industry's constant search for new and better methods of conservation—Creole Petroleum Corporation's Tia Juana No. 1 Conservation Plant. Here, ten General Electric gas turbines drive compressors to return previously flared gas under pressure to the underwater oil field, thus increasing Creole's oil yield.

Accumulated data prove that the performance of the ten G-E gas turbines has exceeded all expectations. In the first thirteen months, during which time the machines accumulated 89,000 hours of operation, availability of individual turbines was a remarkable 98 per cent. In fact, unscheduled gas turbine downtime has never caused the plant to shut down. Originally planned to pump 137 million standard cubic feet of gas per day, the platform has pumped as much as 170.8 million cubic feet per day on a weekly average.

Versatile, economical, compact G-E gas turbines are already at work in a diversity of applications. Why not check into the advantages they can bring to your operation? Your nearest G-E Apparatus Sales Office can furnish you complete information. General Electric Co., Schenectady 5, New York. 261-21



PUMPING 24 HOURS A DAY, compressors driven by General Electric gas turbines maintain pressure in Creole Petroleum's vast oil fields under the waters of Lake Maracaibo, increasing the recovery of oil and conserving large volumes of gas for future use

Progress Is Our Most Important Product

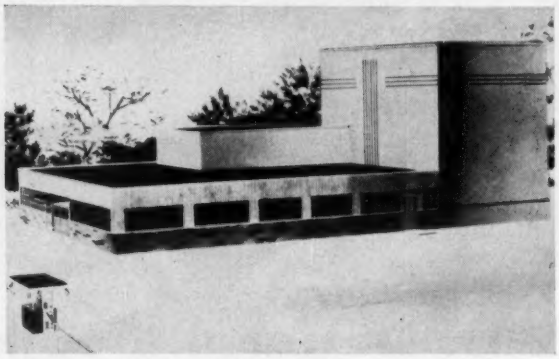
GENERAL ELECTRIC

REPORTS FROM THE FIELD

What's happening in power and what it means to you

For Calendar of Events see page 228

NUCLEAR FABRICATION PLANT has complete facilities for producing fuel elements in a variety of alloys, shapes, sizes



CRITICAL EXPERIMENTS FACILITY will be used for simulating actual core operations to confirm theoretical calculations

B&W opens first privately-owned atomic products plant

► OPERATIONS HAVE BEGUN at The Babcock & Wilcox Company's Nuclear Facilities Plant—the nation's first major facility built entirely at private expense to make and test nuclear fuel elements and related products for peacetime use.

Located six miles east of Lynchburg, Va., the plant is divided into a nuclear fuel element fabrication building and an experimental unit where reactor core components will be studied and tested.

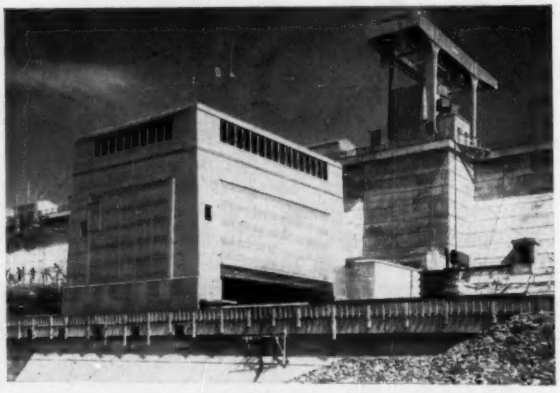
The fabrication building has complete metal casting, rolling, welding and machining equipment to turn out flat-plate type fuel elements. And provisions have been made to add facilities necessary to make pin, rod and cylindrical type fuel elements. Production is underway here on a year's supply of fuel for the AEC's Materials Testing Reactor at Arco, Idaho. Delivery of the first 35 assemblies under this contract is scheduled for August.

The experimental facility is slated for completion in the near future. A reinforced concrete bay, nearly three stories high with walls up to 3-ft thick, forms the test chamber for critical assemblies. Space for offices, shops, a control room, laboratories, a vault and other units has been built into a low wing of conventional construction adjoining the bay.

Initial operations in the experimental facility will determine the nuclear characteristics of the Consolidated Edison Co of New York reactor design. The first core assembly made to one-quarter scale will be tested at a power level that will seldom exceed output of an ordinary flashlight battery. Thorium, which is converted to new reactor fuel as fissioning takes place, will be a component of fuel elements used in these tests, representing the first nuclear use of thorium by private industry.

Although materials used at the plant are not highly radioactive, extreme precautions have been taken to prevent as much as possible human contact with even the most minute particles of these substances. At the same time a "health physics" program, in which the science of physics supplements regular health and safety planning, has been instituted to protect employees and area residents.

Much of the equipment used in this program serves as an aid in accounting for location and disposition of costly nuclear materials. One fuel element component, uranium-235, runs as high as $11,000 a pound, and materials used in the Consolidated Edison experiments alone will be worth about $7 million. Under a rigid "accountability" system there is a continuing search for these special materials down to the last one one-hundredth of a gram—an amount smaller than a grain of sand. (*Continued on page* 226)



Gantry crane will lift 300 tons

► A 300-TON GANTRY CRANE, Canada's largest, is being designed and built by Dominion Bridge Co Ltd for the Ontario half of the 2,400,000-hp hydro plant under construction in the international section of the St. Lawrence River. The unit, weighing 425 tons, will (*Continued on page* 226)

B&W HOLLOW FORGINGS ARE SUPPLIED IN THE FOLLOWING STANDARD MATERIALS

CARBON STEELS

ASTM A 106 Grade A
ASTM A 106 Grade B
ASTM A 106 Grade C

Analyses such as SAE or AISI carbon steel will be considered if quantities are sufficient.

INTERMEDIATE CROLOYS
ASTM SPEC. A 335

Carbon Moly	P 1
Carbon Moly High Silicon	P 15
Croloy ½	P 2
Croloy 1	P 12
Croloy 1¼	P 11
Croloy 1¾	P 3
Croloy 2	P 3b
Croloy 2¼	P 22
Croloy 3M	P 21
Croloy 5	P 5
Croloy 5 Si	P 5b
Croloy 7	P7
Croloy 9-M	P 9

ASTM Spec. A 335 has superseded and replaced ASTM Specs. A 158, A 206, A 280 and A 315.

This list includes all grades of A 335 except grade P 5c, which we do not make.

B&W Croloys, 2½, 3, 5M, 7M, and 9, are not included in A 335. We will supply these additional alloys in accordance with A 335, except for chemistry, upon request.

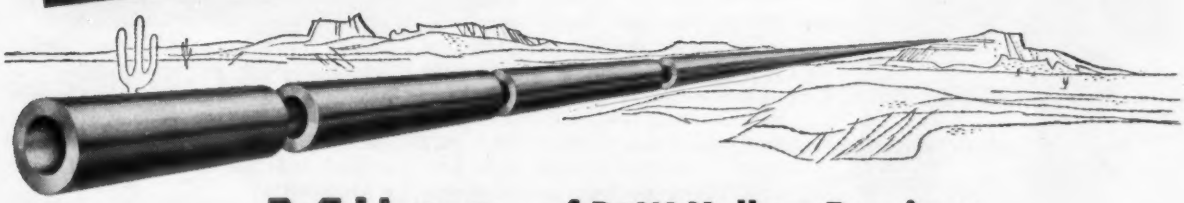
STAINLESS STEELS
ASTM SPEC. A 312

Croloy 18-8	TP 304
Croloy 18-8 Ti	TP 321
Croloy 18-8 Cb-Ta	TP 347 (Cb-Ta)
Croloy 18-8 Cb	TP 347 (Cb)
Croloy 16-13-3	TP 316

These grades will also be made to ASTM specification A 376 excluding "special inspection" requirements.

Other grades of Stainless Steel listed under A 312 are TP 309, TP 310, TP 317. These grades are presently not offered as standard, but will be considered on request.

Sold in just one year!



Miles of B&W Hollow Forgings

. . . in a range of analyses with sizes up to 35" O.D.

Many miles of B&W Hollow Forgings, of all sizes and analyses, were sold for use in the power, petroleum and chemical industries in 1955. Excellent manufacturing facilities, plus B&W's ability to accept orders for both large and small quantities for definite deliveries, are some of the factors that have resulted in this widespread preference for B&W Hollow Forgings.

For the complete B&W Hollow Forgings story, send for new Bulletin S-16B. The Babcock & Wilcox Company, Process Equipment Department, Barberton, Ohio.

BABCOCK & WILCOX

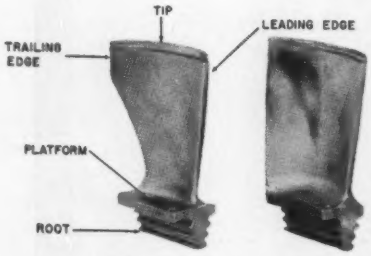
BOILER DIVISION

S-454-A

TECHNICAL BRIEFS

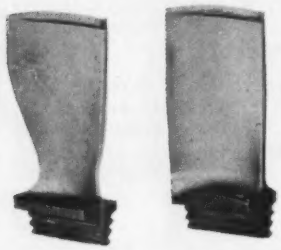
Latest engineering developments for busy power men

24 Papers for you on
GAS TURBINES
HYDRO DEVELOPMENT
FUELS AND FIRING
PUMPS, BOILERS



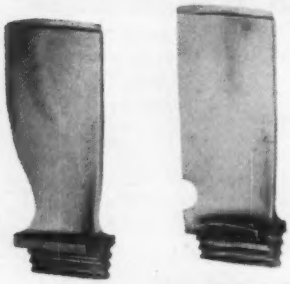
1952 1955

First row rotor blades



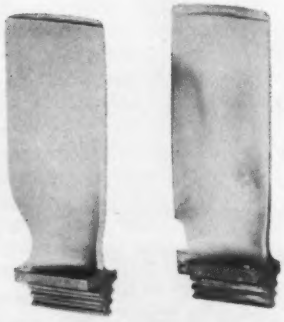
1952 1955

Second row rotor blades



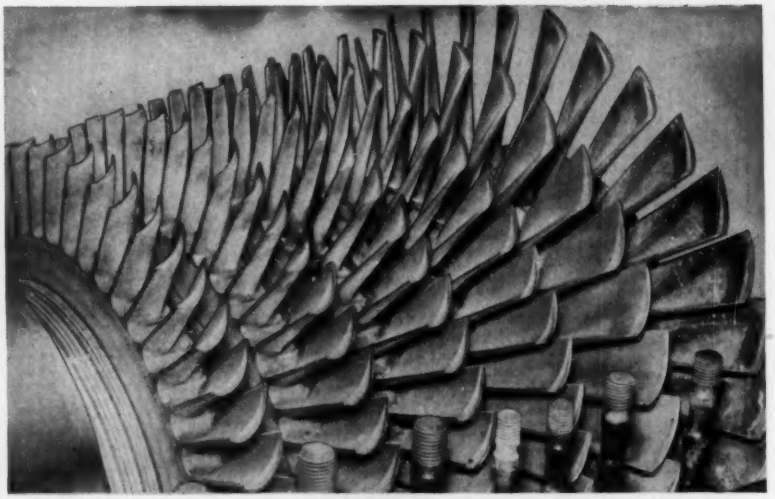
1952 1955

Third row rotor blades



1952 1955

Fourth row rotor blades



ROTOR BLADES of the gas turbine after the operating periods of the 1955 test year

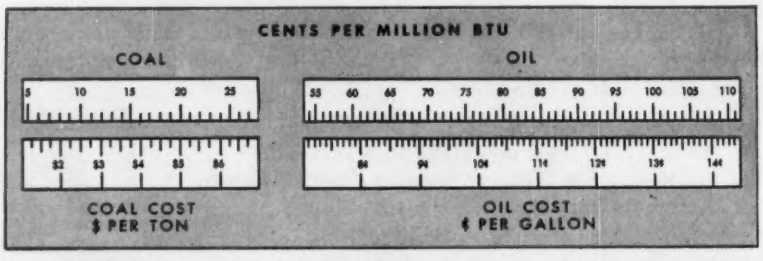
Tests continue on coal-fired gas turbine, show much promise

High load testing of the coal-fired gas turbine. *By P R Broadley and W M Meyer, Bituminous Coal Research, Inc.*

This paper describes the 1955 test program carried out on the Locomotive Development Committee 3540-hp Allis-Chalmers gas turbine. During this year the unit accumulated 1421 hours of coal-fired operation in 83 days. Total horsepower hours generated were 4,111,400 at an average load of 2894 hp (81.7% load factor). Coal burned was 2250 tons, costing $11,300; no lube oil was added during the 1955 tests.

Diesel locomotives, according to the paper, would burn about 256,000 gallons of fuel oil when doing the same job. Allowing 6% of the fuel cost for lube oil, total cost would be $28,745. Savings when using bituminous coal costing 20 cents per million Btu instead of diesel fuel at 83 cents per million Btu approximate $17,450. In an operating year of 4000 hours, saving in fuel and lube-oil costs would be about $49,000.

Items discussed in the paper include condition of the turbine rotor after operation, blade shapes and wear, combustor condition, rotary coal pump, pulverizer and fuel costs. *APC paper; no number.*



RELATIVE FUEL COSTS for coal and diesel fuel for use in gas-turbine locomotive

Which packing
for longer life in reciprocating service?

To 500F it's J-M Interlocked

because it cannot ravel or come apart

Made by an exclusive J-M process, Interlocked packing is braided from tough long-fibre asbestos yarns strongly interlocked in a solid integral structure. There are no jackets to wear through . . . no plaits to loosen. That's why it retains its strength and efficiency far longer than other types.

Interlocked also seals better. It is flexible and resilient, braided square for better contact and requires less gland pressure. Style 255 is effective against steam, hot or cold water, oil, weak acids and caustics. Furnished lubricated and graphited in ring and coil forms in sizes from ¼" and up.

To 750F it's J-M Superheat

because it does not harden under high heat

Designed specifically for superheated steam between 500F and 750F, Johns-Manville's Superheat packing is made of highest quality pure asbestos cloth which retains its resiliency even after long exposure to high temperatures. Woven tight, spiral wrapped and then pressed square, this cloth forms a firm resilient structure of superior strength and wearability.

Style 167 Superheat is bonded with a special heat resistant compound. No excess is present to carbonize in use. Density is carefully controlled for minimum gland pressure. Furnished graphited in ring and coil forms in sizes from ¼" and up.

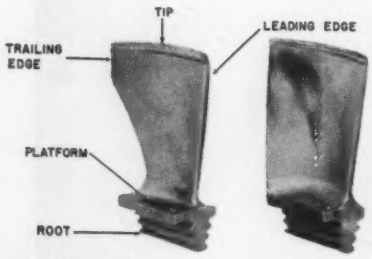
Your local J-M distributor carries full stocks of Interlocked and Superheat and other packings. Call him today or write Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit, Ontario.

Johns-Manville PACKINGS, GASKETS and TEXTILES

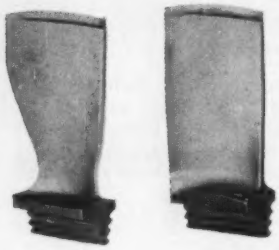
TECHNICAL BRIEFS

Latest engineering developments for busy power men

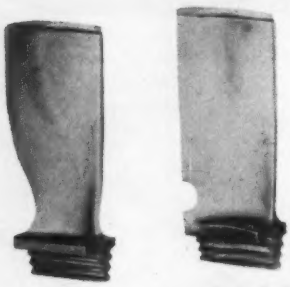
24 Papers for you on
GAS TURBINES
HYDRO DEVELOPMENT
FUELS AND FIRING
PUMPS, BOILERS



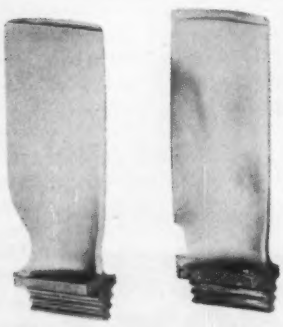
First row rotor blades



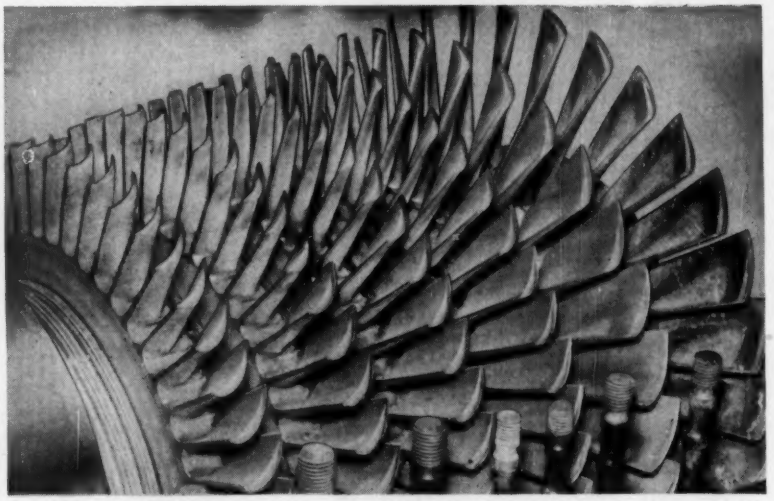
Second row rotor blades



Third row rotor blades



Fourth row rotor blades


ROTOR BLADES of the gas turbine after the operating periods of the 1955 test year

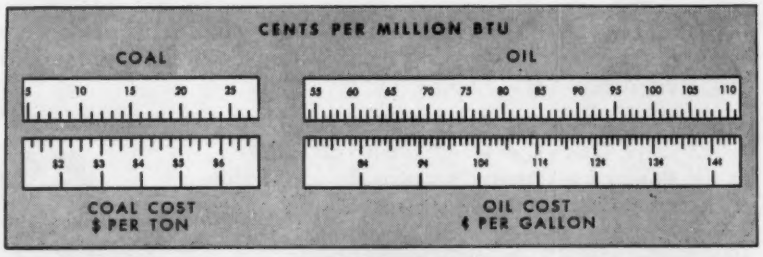
Tests continue on coal-fired gas turbine, show much promise

High load testing of the coal-fired gas turbine. *By P R Broadley and W M Meyer, Bituminous Coal Research, Inc.*

This paper describes the 1955 test program carried out on the Locomotive Development Committee 3540-hp Allis-Chalmers gas turbine. During this year the unit accumulated 1421 hours of coal-fired operation in 83 days. Total horsepower hours generated were 4,111,400 at an average load of 2894 hp (81.7% load factor). Coal burned was 2250 tons, costing $11,300; no lube oil was added during the 1955 tests.

Diesel locomotives, according to the paper, would burn about 256,000 gallons of fuel oil when doing the same job. Allowing 6% of the fuel cost for lube oil, total cost would be $28,745. Savings when using bituminous coal costing 20 cents per million Btu instead of diesel fuel at 83 cents per million Btu approximate $17,450. In an operating year of 4000 hours, saving in fuel and lube-oil costs would be about $49,000.

Items discussed in the paper include condition of the turbine rotor after operation, blade shapes and wear, combustor condition, rotary coal pump, pulverizer and fuel costs. *APC paper; no number.*


CENTS PER MILLION BTU
COAL
OIL
5 10 15 20 25
55 60 65 70 75 80 85 90 95 100 105 110
$2 $3 $4 $5 $6
8¢ 9¢ 10¢ 11¢ 12¢ 13¢ 14¢
COAL COST
$ PER TON
OIL COST
¢ PER GALLON
RELATIVE FUEL COSTS for coal and diesel fuel for use in gas-turbine locomotive

Which packing
for longer life in reciprocating service?

To 500F it's J-M Interlocked

because it cannot ravel or come apart

Made by an exclusive J-M process, Interlocked packing is braided from tough long-fibre asbestos yarns strongly interlocked in a solid integral structure. There are no jackets to wear through . . . no plaits to loosen. That's why it retains its strength and efficiency far longer than other types.

Interlocked also seals better. It is flexible and resilient, braided square for better contact and requires less gland pressure. Style 255 is effective against steam, hot or cold water, oil, weak acids and caustics. Furnished lubricated and graphited in ring and coil forms in sizes from ¼″ and up.

To 750F it's J-M Superheat

because it does not harden under high heat

Designed specifically for superheated steam between 500F and 750F, Johns-Manville's Superheat packing is made of highest quality pure asbestos cloth which retains its resiliency even after long exposure to high temperatures. Woven tight, spiral wrapped and then pressed square, this cloth forms a firm resilient structure of superior strength and wearability.

Style 167 Superheat is bonded with a special heat resistant compound. No excess is present to carbonize in use. Density is carefully controlled for minimum gland pressure. Furnished graphited in ring and coil forms in sizes from ¼″ and up.

Your local J-M distributor carries full stocks of Interlocked and Superheat and other packings. Call him today or write Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit, Ontario.

Johns-Manville PACKINGS, GASKETS and TEXTILES

More TECHNICAL BRIEFS

Begins on page 150

Gas turbines

The gas turbine—a versatile servant for the process industries. *By W B Wilson, General Electric Co.*

Gas turbines available today can (1) generate electric power (2) supply shaft power to drive pumps, compressors, fans, etc (3) supply compressed air for process (4) supply highly preheated combustion air for catalyst regeneration or for various stoves, furnaces and boilers (5) supply heat for process and (6) supply steam for process or other power uses.

After a brief discussion of what the gas turbine is and how it works, this paper (a) discusses fuels best suited for use in the gas turbine (b) lists data on the hours of operating experience and reliability of gas turbines now in service (c) discusses size ranges available (d) considers a few applications where the gas turbine may lower operating costs and permit more profit and (e) shows ability of gas turbines to utilize surplus gas available from some processes at elevated pressure and temperature. *AIEE paper No. 56-425.*

The development of a 500-hp multipurpose gas-turbine engine. *By P G Carlson and I M Swatman, Solar Aircraft Co.*

This paper describes the *Solar Jupiter T-520J* single-shaft unit and the *T-522J* two-shaft version. Both these gas turbines were developed from the *Model T-400J*, installed in the *USS Timmerman* in 1951. It was the first gas-turbine engine ever installed in a U.S. Navy vessel.

Under Bureau of Ships sponsorship a program was undertaken to (1) redesign engine components found troublesome in the *T-400J* unit (2) increase power output and thermal efficiency and (3) extend engine running time to prove reliability of the modified unit.

Design objectives have been achieved. Indications appear to show that maintenance costs are less than those of competitive internal-combustion engines. *ASME paper No. 55-S-36.*

Gas turbines for peak load generation on a large utility system. *By W D Marsh and C M Wright, General Electric Co.*

Rapid increase in the rate of peak load growth in many parts of the U.S. focuses new attention on how future peak loads will be met. To continue past practice means that today's high-pressure reheat units will be tomorrow's peaking machines. It seems reasonable to ask if there may be more economical solutions, using prime movers better suited to the frequent starts and stops of peaking service.

The authors believe use of low-cost gas-turbine peaking stations offers the most promising solution, particularly for large systems. Recent developments show prospects of gas-turbine station costs of $100 per kw, or less. The paper discusses (1) types of gas turbines best suited for peaking (2) system economics (3) a typical application. *APC paper; no number.*

Increased life for gas turbine combustion systems burning residual fuel. *By R W Macaulay and C M Gardiner, General Electric Co.*

This paper describes a new type of liner and fuel nozzle which, on the basis of limited field experience, have shown improved life with fewer changes. It also gives a brief review of test data and operating experience on combustion liners and fuel nozzles. *ASME paper No. 56-GTP-11.*

Gas turbine for mobile power unit. *By F O Hennig, Clark Brothers Co.*

This paper is a continuation of a previous paper that described the overall design of major components of a mobile power unit. Concerned only with main power equipment, the present paper offers a detailed description of design features developed for this project. It also covers considerations of flexibility necessary to make this gas turbine suitable for other applications. *ASME paper No. 56-GTP-10.*

Development of high-speed sleeve bearings for a Solar 500-hp gas-turbine engine. *By D E Blackwood, Bureau of Ships, Navy Department and I M Swatman, Solar Aircraft Co. ASME paper No. 56-GTP-14.*

33,000 hours on marine gas turbines in naval service. *By W M M Fowden Jr and J W Sawyer, Bureau of Ships, Navy Department. ASME paper No. 56-GTP-7.*

Operating experience and design features of closed-cycle gas-turbine power plants. *By Curt Keller, Escher Wyss Ltd. ASME paper No. 56-GTP-15.*

Directions for ordering papers on page 220

Hydro development

Hydro-power in the Northwest. *By J P Buehler, Bechtel Corp, and O E Walsh, Portland General Electric Co.*

Hydro power has been a major and a basic economic factor in the relatively recent rapid growth and industrial expansion of the Northwest. Actual peak loads in this area have grown from 700,000 kw in 1920 to about 7.14 million kw in 1954. This growth was equivalent to an average increase of 7.39% each year over the 33-year period.

Items discussed include the Northwest power pool, potential hydro power developments, projects for 69 plants, partnership principle, problems in achieving adequate power development and hydro-thermal systems in the Northwest. *ASME paper No. 56-S-9.*

An economic appraisal of nuclear versus hydro power development in the Pacific Northwest. *By K M McCaffree, University of Washington.*

Rapid advances in reducing nuclear power costs raise the question of the feasibility of further hydro power development in this region. When, if not now, will nuclear power become competitive with or replace hydro facilities as the primary power source in this region?

The paper surveys both types of generation costs. On basis of the study, the author concludes that after 1970 a significant part of base-system needs in the Pacific Northwest will probably be met by nuclear power sources. *ASME paper No. 56-S-19.*

Fuels and firing

Chemical treatment for fireside deposit prevention in coal-fired boilers. *By Harris Thompson, National Aluminate Corp.*

Trouble from fireside deposits and corrosion in boiler furnaces has increased greatly in the past 15 years. This is due to a number of factors, including: (1) increased rating of existing units (2) economic pressures to burn lower cost fuels and (3) critical gas temperature operating ranges in modern high-pressure boilers.

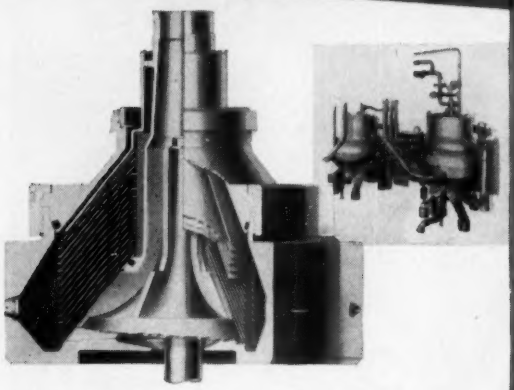
Work to solve this problem, has been done by: (1) improving boiler and furnace design and cleaning equipment (2) coal selection and (3) chemical treatment application.

The paper's objective is to outline the

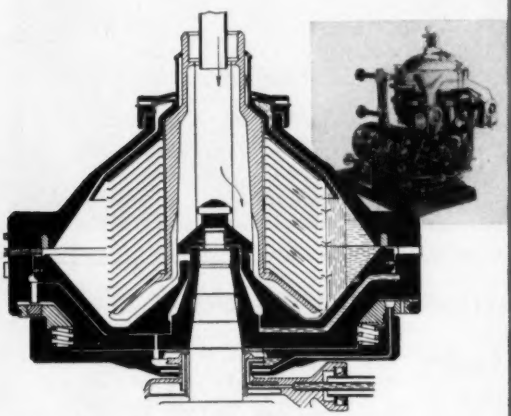
(*Continued on page* 216)

IF YOU CAN PUMP IT, WE CAN PURIFY IT.....

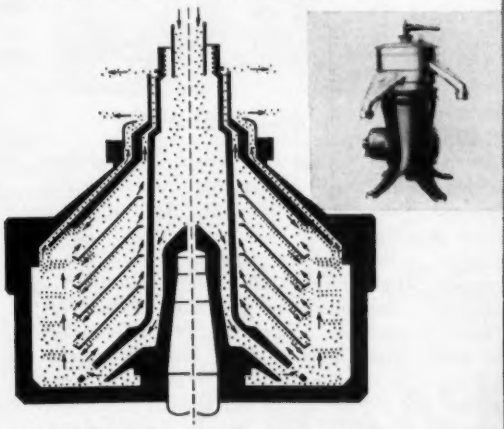
CONTINUOUSLY!



AC-VO "Nozzle-Matic"® Continuous Purifier



PX 209.00 Self-Cleaning Centrifuge



Model 94 Standard Solid Bowl Purifier

Only De Laval offers you every type of heavy fuel oil centrifuge . . . for *both* small or large size plants—ashore or afloat!

Take your choice! . . . select the type that precisely fits your requirements . . . gives you greatest economy.

All three De Laval Heavy Oil Purifiers have demonstrated their efficiency *in service* . . . have proved they do their job so well that the savings are *actual,* not dissipated in added maintenance expense.

Complete details on request . . . without obligation.

RECOMMENDED CAPACITIES—G. P. H.

VIS.	TEMP.	AC-VO	PX 209. F	MODEL 94
500	180° F	1200	600	300
700	180° F	1100	550	275
1700	180° F	660	330	165
2500	180° F	560	280	140
4000	190° F	440	220	110
5000	200° F	300	150	75

DE LAVAL

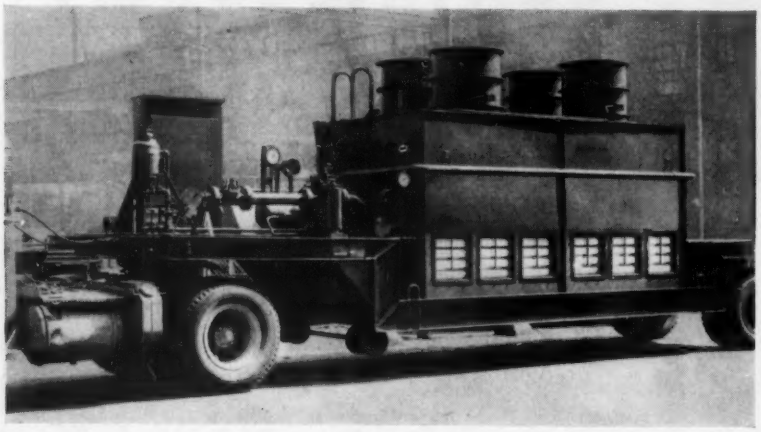
Heavy Oil Purifiers

THE DE LAVAL SEPARATOR COMPANY Poughkeepsie, New York • 427 Randolph St., Chicago 6 • DE LAVAL PACIFIC CO. 201 E. Millbrae Ave., Millbrae, Calif.

PLANT EQUIPMENT NEWS

Your information center for new products designed to solve plant problems

Published monthly as a service to readers



Versatile, portable water-cooling tower

701 • Wheel-mounted unit is designed to ease industrial situations where limited cooling-water supplies have been the cause of production bottlenecks.

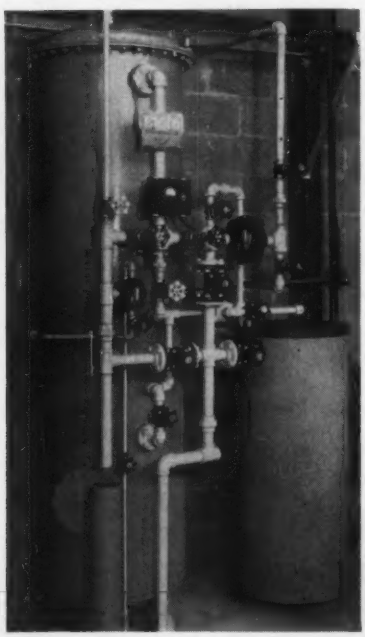
Compact and lightweight, unit is equipped with all necessary accessories such as pumps, strainers, electrical control equipment, pressure gages, thermometers and feedwater conditioner. Design capacity of the unit shown is 240 gpm of 115 F water reduced to 90 F when operating at 95 F air temperature and 80 F wet bulb.

According to the manufacturer, the tower is presently being used in conjunction with portable oxygen-generating plants in remote locations. It can also be used by small chemical plants, small diesel-power stations with large volumes of cooling water to recirculate, or, in many instances, by air-conditioned buildings.

The tower pictured is constructed of steel and is packed with 20-in. *Fiberglas*. The entrainment separator is a special copper mesh and the four axial flow fans have a capacity of 11,000 cfm each. The entire cooling plant is wheel-mounted, can be shipped as a complete unit, ready for immediate service. Further details from manufacturer.

Badger Manufacturing Company, Cambridge, Massachusetts

For more data on these items, use post cards on page 163. Identify your request with item number.

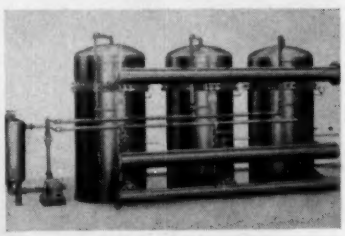


Mixed-bed deionizers

702 • Unit removes all ionizable impurities, including carbon dioxide and silica, and delivers chemically pure water. Under field conditions, water with specific resistance of 1 to 20 million ohms, or specific conductance of 1 to 0.05 microhms is possible. Since triple-distilled water rarely exceeds 1 million ohms specific resistance, this equipment has wide use where distillation or evaporation has failed to meet needs, according to manufacturer.

The unit contains mixed cation and anion exchange resins that produce in effect a multi-multiple bed deionizer. No leakage of cations or anions occurs. Manufacturer states that the "double-check" design used increases capacity for deionized water, for a given tank size, up to 44%. This arrangement permits more thorough backwashing—keeps exchange resins clean, efficient.

Elgin Softener Corp, 130 N Grove Ave, Elgin, Illinois



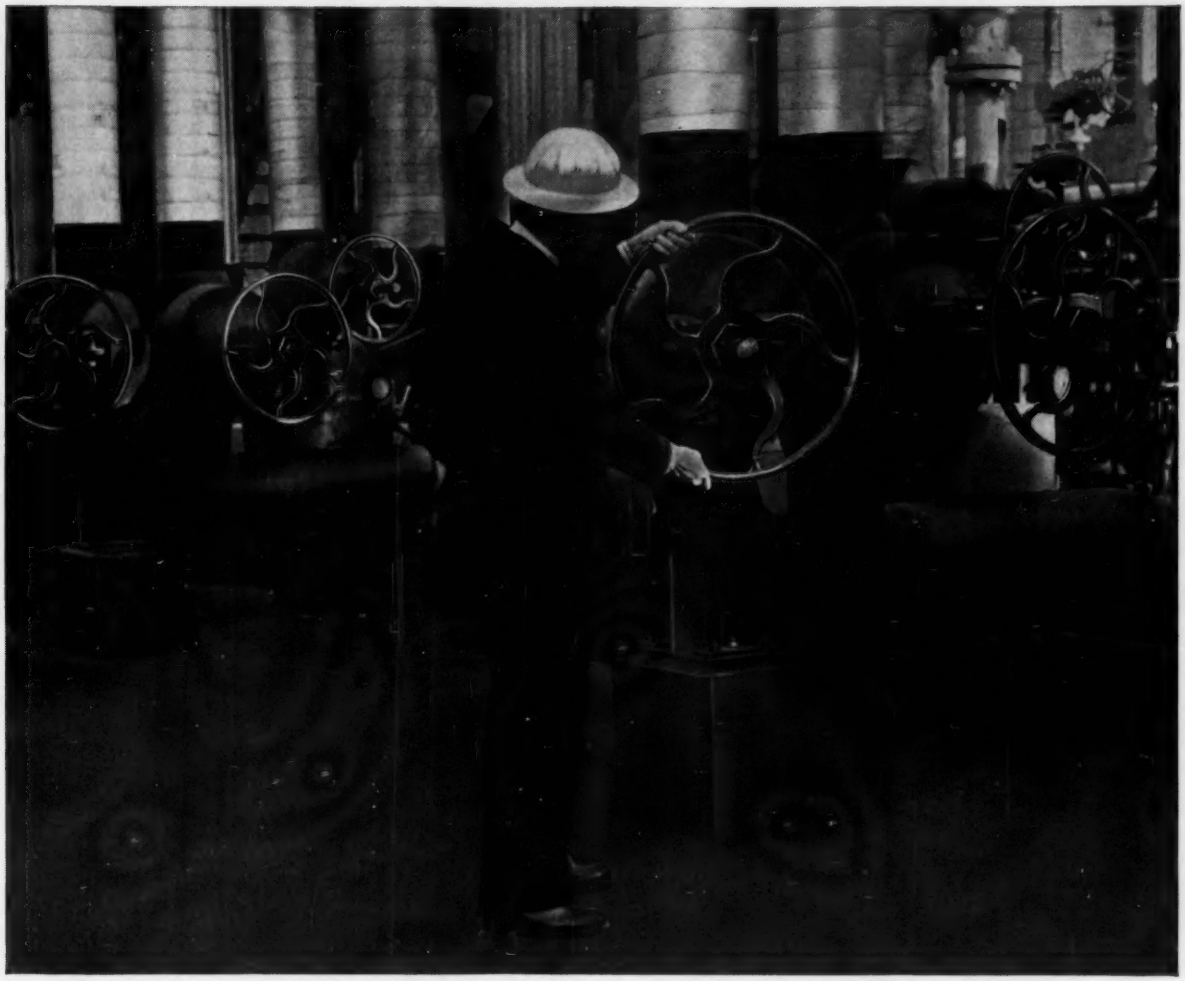
Industrial filter line

703 • *Type IWF* filters use high-flow backwash design that eliminates disassembly for cleaning. Air trapped in high dome forces backwash liquid through filter elements at high velocities, purging all foreign matter from element's pores. Five sizes, in numerous multiple arrangements, are available. Four different filter elements provide a suitable septum for most processes.

Photo shows typical filter plant with *Triple IWF-197*, precoat pump and pot.

R P Adams Co, Inc, 311 E Park Dr, Buffalo 17, N. Y.

Industrial fan designs, other equipment news, on page 156



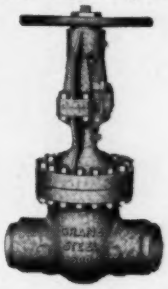
No repairs, no maintenance for these Crane valves —after 12 years on feed-water service

The day these Crane steel valves were installed 12 years ago, they started saving money for the Neches Butane Products Company's butadiene plant in Texas.

Not once have these 8-inch No. 76½ XR steel gate valves required repairs—not once have they needed maintenance . . . and they've been on hard, continuous service on lines to boiler feed pumps in this 3 million pound-per-hour steam plant.

There's more than meets the eye to valve service like this. From the outside, the average person wouldn't know the difference between Crane valves and others of the same type. That's why those who know valves investigate the *inside* quality before they specify. When the valves are Crane, they don't have to look far to find this quality—quality in materials, engineering and construction that literally means the difference between long, cost-free performance and expensive, aggravating, down-time maintenance.

Don't take chances with your all-important valves. Specify Crane, and make *sure* of getting service you can depend on—with the world's most complete line to select from, backed by a century of unparalleled experience in serving industry.



Get full information from your local Crane Representative, or write to address below.

CRANE VALVES & FITTINGS

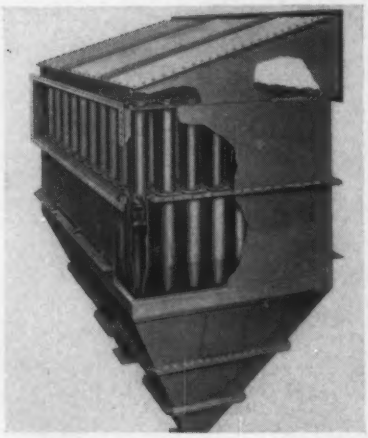
PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

More EQUIPMENT NEWS

Begins on page 154

Multiple-tube collector ups gas-cleaning efficiency

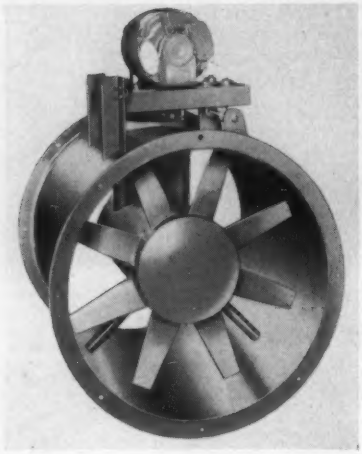


704 • *Cyclo-trell* centrifugal dust collector is designed for higher gas flow than has previously been obtainable with multiple-tube units. Aerodynamic vane design produces higher velocities in inlet tubes and increases gas flow in outlet tubes. Purpose of inlet vanes is to start a fast spiral of incoming gas with a minimum of turbulence. Faster the gases spin, greater the centrifugal force on suspended dust in the gas stream. "Drop out" and collection efficiency are higher as this centrifugal force is increased.

Greater capacity means fewer tubes per unit are needed. Request details.

Research-Cottrell, Inc,
Bound Brook, N. J.

Axial flow fans meet industrial cooling demands

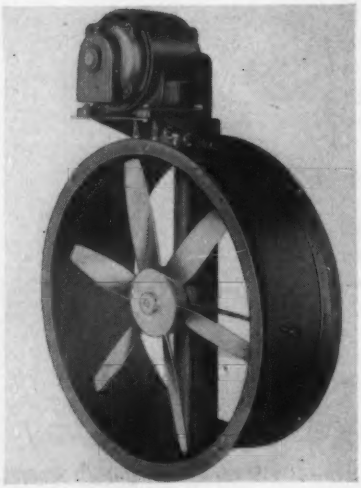


705 • Aerodynamically designed units feature wider blades that reportedly offer higher pressure characteristics with less operating noise. Hub-tip ratio enables larger blade angles near hub to produce a pressure equal to that against which the unit as a whole is working. Blade angles decrease to small values at the tip. Result: the more even delivery of air velocity across entire fan blade eliminates back flow that might occur around hub.

Belt-driven and direct-motor-powered models are available. Fan diameters run from 12 to 72 in., have air-moving capacity of 1200 to 100,000 cfm. Full details from manufacturer.

Detroit Blower Corp, 9867
Pacific Ave, Franklin Park, Ill.

Tubeaxial fans find wide industrial application



706 • Belt-driven tubeaxial fan is recommended for paint-spraying booths, ventilation, exhaust and numerous other industrial applications. Diameters are said to match standard duct sizes. Various selections of horsepower for each size allows a wide range of air capacities. V-belt drive and motor are isolated from air stream so there is no contamination to motor or belt from vapors carried in duct work. Fan blades are non-sparking heavy cast aluminum—suitable for handling explosive gases. Both fan and motor are fitted so that they may be mounted in any position. Details on request.

The Peerless Electric Co, Fan
and Blower Div, Warren, Ohio

Lightweight pipe bender

707 • Remote-control bender makes any degree bend in one setting. It is available for pipe, rigid conduit, bus bar and radiant-heat, EMT or copper tubing, and with a pipe straightener, if used with standard all-purpose frame.

The bending frame has a removable top plate that permits laying pipe in from the top, sliding pipe in from side or hooking the bender over installed pipe. Request further information from the manufacturer.

Tal Bender, Inc, 417 N Water St,
Milwaukee 2, Wis.

Electric bin vibrator

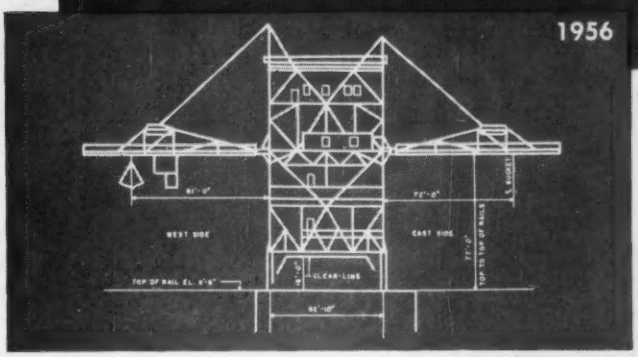
708 • Lightweight (25-lb) vibrator is designed for use on hoppers, bins, chutes, packers and other bulk-handling equipment. Built on rotating eccentric weight principle, unit makes no more noise than an electric motor, manufacturer states. It draws 100 watts, delivers 275-lb impact. Further data on request.

The Cleveland Vibrator Co,
Cleveland 13, Ohio

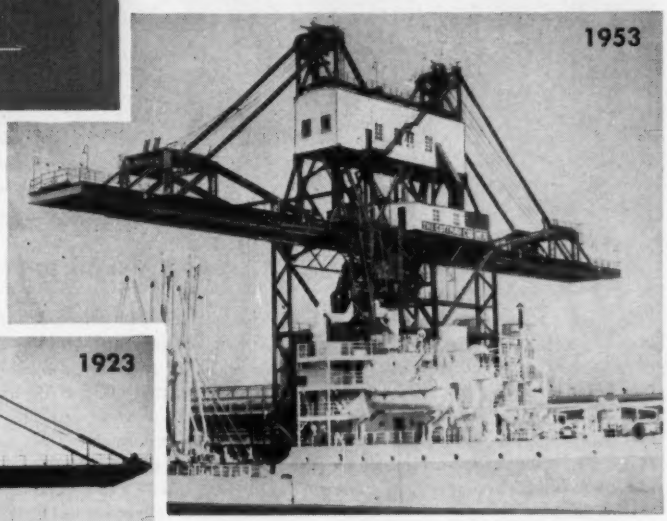
For details on these items, use post cards on p 163. Identify request with item number.

Equipment developments in the electrical field, turn page ▶

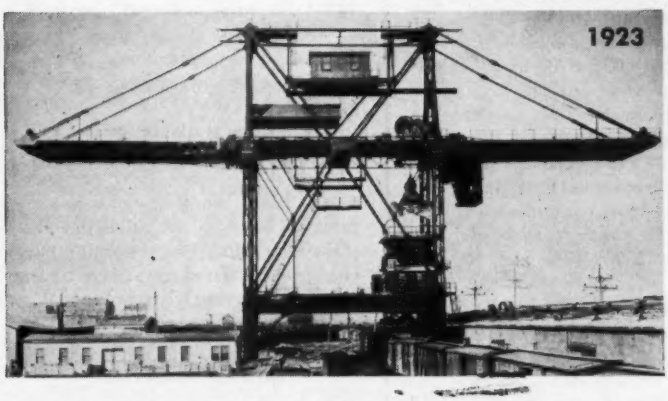
The Last 3 of 4 Boat Unloaders on the CANTON RAILROAD ORE PIER by HEYL & PATTERSON



No. 4 Boat Unloader by H & P, now being built, is almost a duplicate of the No. 3 Boat Unloader by H & P.



No. 3 Boat Unloader by H & P has been in operation since 1953.



No. 2 Boat Unloader by H & P has been operating since 1923 for The Cottman Company, Subsidiary of the Canton Co. of Baltimore, Md.

These three H & P unloaders located on the Canton Company Pier in Baltimore, are capable of unloading all kinds of ore directly into railroad cars or onto a high-line belt conveyor for remote loading into cars. All of these H & P unloaders are equipped with turntable trolleys to promote speedy cleanup, thus providing minimum turn-around time for both small and large carriers.

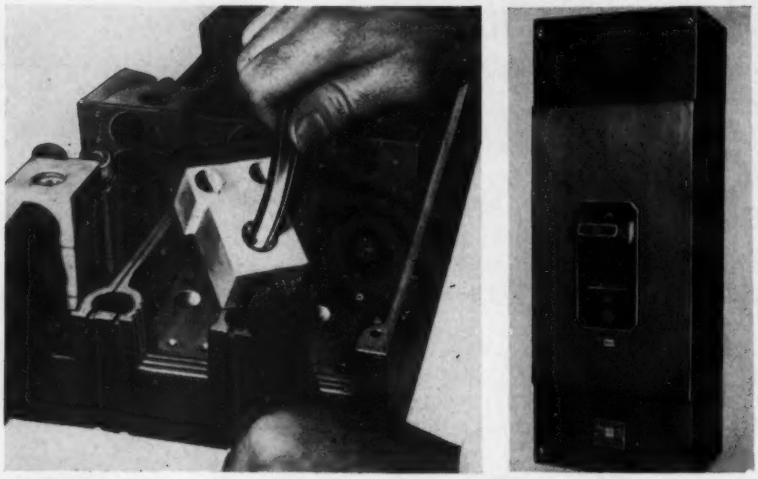
Heyl & Patterson INC.

55 FORT PITT BLVD. • PITTSBURGH 22, PA.
PHONE COurt 1-0750

More EQUIPMENT NEWS

Begins on page 154

Latest developments in the electrical field



MULTIPLE PRESSURE CABLES at each phase are individually connected and mounted in stacked arrangement, *left*. Photo, *right*, shows outside case of 800-amp breaker

800-amp molded-case circuit breaker gets UL approval

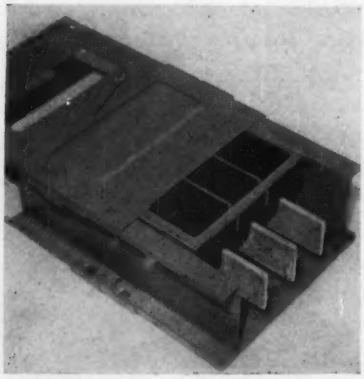
709 • This 800-amp M-frame circuit breaker is first molded-case breaker to be approved by Underwriters' Laboratories for operation at this continuous current rating, according to manufacturer. It extends operating range of molded-case breakers from 600 to 800 amp, providing higher continuous current rating that previously required larger and more expensive equipment.

No larger than company's L-frame breaker rated at 600 amp, the 800-amp unit can be used in panelboards, power panels, switchboards, motor controls, bus-duct plugs and individual enclosures. Optional pressure connectors are offered for either double or triple cable connections per phase within the circuit breaker case. Double 300 to 500 mcm cable connectors are available for breakers rated 600 to 700 amp. Triple 300 to 400 mcm or special double 600 to 750 mcm connectors are available on units rated 800 amp.

Designated *Type ET*, the 800-amp breaker is offered with interchangeable trip units providing continuous 600, 700 or 800-amp ratings in 2- or 3-pole construction for 250-volt dc and 600-volt ac service.

Interrupting ratings are 25,000 amp at 600-volt ac, 35,000 amp at 480-volt ac, 50,000 amp at 240-volt ac and 20,000 amp at 250-volt dc.

I-T-E Circuit Breaker Co, 19th & Hamilton Sts, Philadelphia 30, Pa.



Plug-in bus duct

710 • New design of insulator for plug-in bus duct for heavy-duty commercial and industrial electrical distribution reportedly withstands fault currents of 50,000 rms amperes. According to manufacturer, performance tests were conducted on type 50,000 WC plug-in bus duct loaded with 3-phase fault currents ranging between 46,000 and 57,000 amp. Individual arcing fault tests were held to prove the product under extreme conditions.

Federal Pacific Electric Co, 40 Paris St, Newark 1, N. J.

Electric motor line

711 • These motors are said to be the first in the 1 to 40-hp range to have extruded plastic insulation. They are built in open-type frame and torque design B.

The thermo-setting plastic insulation is molded into and around the stator windings. Result: a winding that is encased in a rigid mass, claimed to have high-resistance to chemical action, humidity, abrasive dust, lint and oil vapor. "Hot spots" confined inside areas of motors that do not receive ventilation are eliminated—the plastic provides a medium for conducting heat uniformly away from every wire. Motors, though built in open-type frame, may be used as splash-proof units or, in many applications, as a totally-enclosed motor.

The Lincoln Electric Co, Cleveland 17, Ohio

Distribution transformers

712 • Improved units will be built in single-phase ratings from 3 to 167 kva, 15 kv, and below. Three-phase ratings will range from 9 to 150 kva, 15 kv, and below.

Key feature available for use with conventional line is an overload indicator that records total overload hours based on copper temperatures. This aids in prediction of transformer life, gives warning for change-out scheduling.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

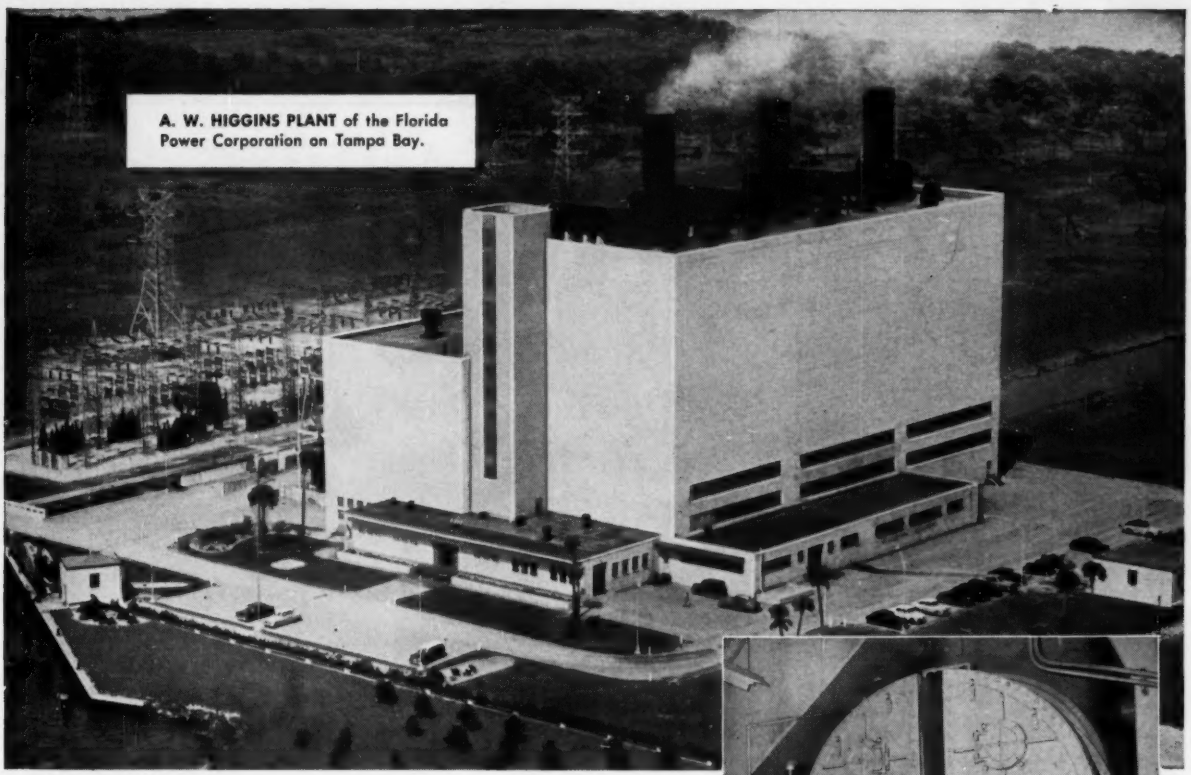
Storage batteries

713 • High-output nickel-cadmium pocket-plate units are used for diesel engine starting, standby power, switch tripping and closing, emergency lighting. Active materials, nickel and cadmium oxides, are locked in perforated steel pockets formed into plates. Cell containers are steel; electrolyte is a solution of potassium hydroxide. No corrosive fumes are given off.

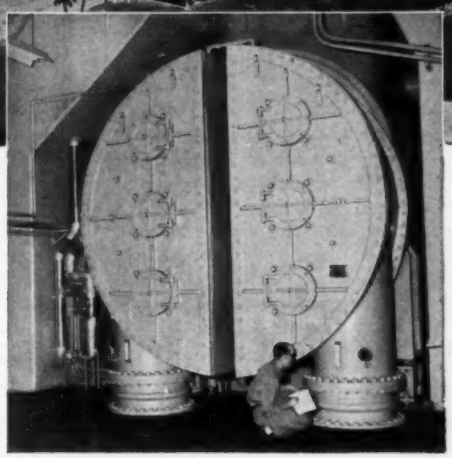
Nickel Cadium Battery Corp, 72 Pleasant St, Easthampton, Mass.

For details on these items, use post cards on p 163. Identify request with item number.

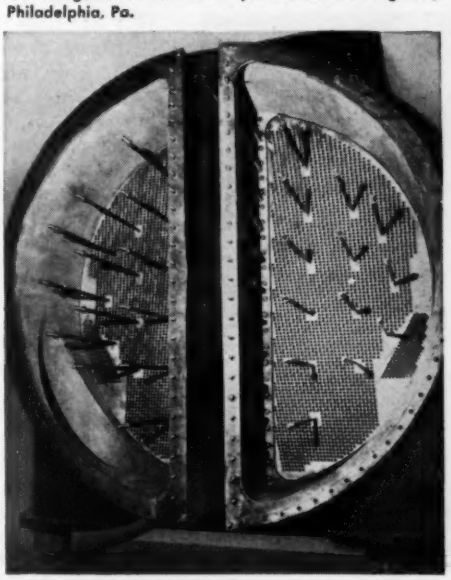
More Equipment News, turn page ▶



A. W. HIGGINS PLANT of the Florida Power Corporation on Tampa Bay.



Exterior view of one of the condensers in the Higgins plant, and below, one of the three condensers ready for tubing. Condensers made by C. H. Wheeler Mfg. Co., Philadelphia, Pa.



REVERE 10% CUPRO-NICKEL SOLVES CORROSION PROBLEM FOR FLORIDA POWER CORPORATION

About six years ago the Florida Power Corporation was experiencing condenser tube failure at its Bayboro plant in St. Petersburg. Revere's Technical Advisory Service was called in, and recommended replacing the failed tubes with 10% Cupro-Nickel, which has a marked resistance to corrosion from brackish water. This recommendation proved successful. As a result, when Florida Power planned to add a new 135,000 KW plant, named after A. W. Higgins, Revere 10% Cupro-Nickel tubes were specified. All three units in the new plant are thus tubed. The tubes are 7/8" OD x 18 BWG, 24' 7" long. A few spares are kept on hand for possible replacement, but with regular cleaning to remove debris (small bits of shell, etc.), the tube life has been exceptional, thus adding to economy of operation and increased service to a fast-growing area. . . . If you have questions regarding condenser tube selection and service, get in touch with the nearest Revere Sales Office. Remember to specify Revere.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

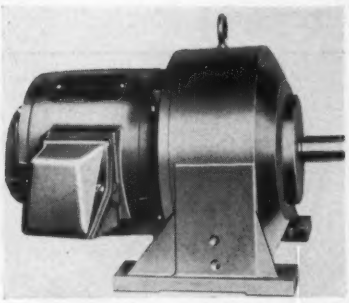
Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N.Y.

Sales Offices in Principal Cities, Distributors Everywhere.

More EQUIPMENT NEWS

Begins on page 154

Three mechanical-transmission items of current interest

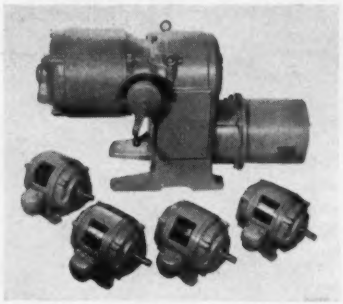


Ac and dc gearmotors

714 • Manufacturer states that these gearmotors combine latest design principles of mechanical gearing and electrical motor development. Available in both ac and dc from 1 through 60 hp, they are designed for trouble-free performance under adverse operating conditions.

Two-way seals permit mounting of the unit in virtually any position without oil leakage. The simple gear train is unencumbered by excess mechanisms. A selection of mountings, enclosures and ratios affords custom gearmotors for all uses.

Reliance Electric & Engr Co, 1088 Ivanhoe Rd, Cleveland, Ohio

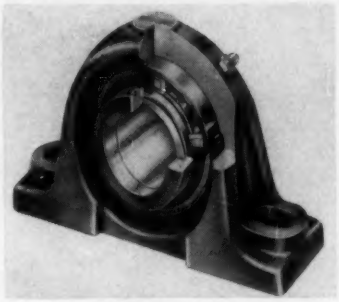


Multiple-drive system

715 • Heart of the system is a power unit that interlocks motors by means of electrical impulses. A control dial on the power unit varies speed of every motor in the system equally and simultaneously.

Varidyne motors used are of the ac, squirrel-cage induction type, connected to the power unit by standard 3-phase circuitry. The power unit will carry from 1 to 50-hp connected load. For complete details request bulletin F-1910 direct from the manufacturer.

U.S. Electrical Motors Inc, Box 2058, Terminal Annex, Los Angeles 54, Calif.



Unit pillow block

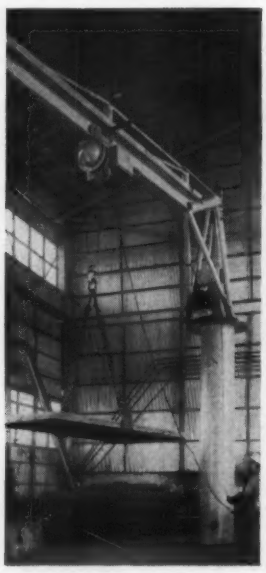
716 • *Type SYH-X* unit pillow block and *Type FY-X* unit flanged mounting extend use of positive seal mounts to applications where an eccentric lock is desired. Pillow block has a reduced center height to permit its use in limited spaces.

Besides being provided with eccentric locks, the units feature positive sealing through use of a *duPont Fairprene* washer to retain lubricant; external rotating flinger to keep out dirt; spherical outer ring to compensate for initial misalignment. Details from manufacturer.

SKF Industries Inc, Front St & Erie Ave, Philadelphia 32, Pa.

For more data on these items, use post cards on page 163. Identify your request with item number.

Power-rotated jib crane will lift up to 15 tons

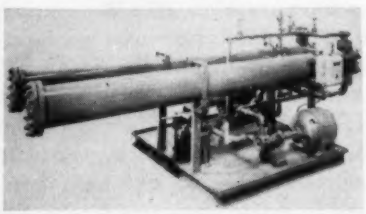


717 • Available in capacities of 6, 7½, 10 and 15 tons, each crane has a 25-ft boom which, when rotated in a full circle, covers 1965 sq ft of floor space. The electric rotating mechanism, as well as the electrically-powered hoist and hoist trolley which are available, are built to provide "inching control" and exact spotting.

Heavy-duty electro-mechanical motor brakes, plus built-in regenerative electric braking action, provide absolute control of both boom and load, according to manufacturer. All controls for both the jib crane and hoist selected are of push-button design, suspended together from the hoist to permit handling by a single operator. Request further information from the manufacturer.

R G LeTourneau, Inc, 2399 S MacArthur, Longview, Texas

Don't miss this item...



Fuel-oil pump, heater sets . . . . . p 168

. . . or these and the many others appearing on pages noted below:

Right-angle gear drives . . . . . p 170
Pressure control valve . . . . . p 172
Pipe sealing compound . . . . . p 174
Differential regulator . . . . . p 176
Rotary oil burners . . . . . p 178
Combination strainer traps . . . . . p 180

WHEN YOU AIR CONDITION

Hotel Peabody, Memphis

Let JOHNSON solve the CONTROL PROBLEMS

Regardless of whose air conditioning equipment you install, its performance is going to depend on how well it is *controlled.*

To be sure you get the *right* control system for your air conditioning equipment—*one that will insure ideal temperatures and provide precision, waste-free heating and cooling operation*—turn the job over to the specialist Johnson organization.

Johnson offers you the benefits of experience gained in individually planning and installing the automatic temperature control systems for most of the nation's better buildings of all types and sizes.

The 625-room air conditioned Peabody Hotel in Memphis is a good case in point. The first installation of Johnson Air Conditioning Control in this famous hotel was made in 1939 when two floors of guest rooms were air conditioned. The modernizing program was completed in three installments between 1947 and 1952.

In guest rooms, Johnson *Individual Room* Thermostats automatically regulate the volume of conditioned air and permit each guest to select his own personal "weather". Perfectly conditioned air is supplied by two central air handling units per floor, all of which are under the precision regulation of Johnson Thermostats, Valves, Dampers and related apparatus.

Comfort control in the main lobby, drugstore, coffee shop, Skyway Supper Club and other public spaces is provided by strategically located Johnson Room Thermostats which insure ideal temperatures at all times. Behind the scenes, other Johnson controllers operate the central air conditioning units serving these areas.

Satisfying, comfortable temperatures prevail constantly in every room in the building—and Johnson Control makes it possible to accomplish all this at a substantial saving in heating and cooling costs!

When you decide to air condition your building, let Johnson help you realize the *full* benefits of your investment. Talk to a nearby Johnson engineer early in your planning. He'll gladly explain how the superior comfort and economy features of Johnson Control can be applied to your particular problems. His recommendations are yours without obligation.

JOHNSON CONTROL

TEMPERATURE AIR CONDITIONING

PLANNING • MANUFACTURING • INSTALLING • SINCE 1885

JOHNSON SERVICE COMPANY

507-S East Michigan St., Milwaukee 1, Wisconsin

We're planning to air condition. Please have a Johnson engineer call on me to discuss our control problems.

NAME_____ TITLE_____

FIRM_____

ADDRESS_____

CITY & STATE_____

Now the finest of needle valves is available

416 Stainless throughout...

In the Marsh Needle Valve, operating men found a valve that was better all the way through. Then came the call for a valve of like quality and precision for corrosion service . . . to be 416 stainless steel throughout.

The valve illustrated here is the answer. Like the parent valve, this new valve has safety and strength to spare . . . guaranteed for working pressures up to 10,000 psi . . . equally efficient and effective in any lower pressure range.

It too is machined from solid bar stock—in this case, 416 stainless steel. Its precision-ground and-machined stem is hardened 416 stainless. Packing is the special "Marpak" ring . . . one-piece, non-binding, long-lasting. So finely built is this needle throttling and cut-off valve that it can be easily throttled down to exceptionally fine regulation even on extreme pressure.

Read the list of features opposite. Then write for new bulletin No. NV-2 containing complete details.

The new all stainless valves (Series 1924) includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾", 1"; also globe and angle valves with male inlet and female outlet in sizes ¼" and ½".

MARSH INSTRUMENT CO. Dept. F, Skokie, Ill.
Sales affiliate of Jas. P. Marsh Corp.

Marsh Instrument & Valve Co. (Canada) Ltd.
8407 103rd Street, Edmonton, Alberta, Canada

HOUSTON BRANCH PLANT: 1121 Rothwell Street, Sect. 15, Houston, Texas

416 Stainless Steel ...all the way through!

- Body and stem guide machined from bar stock.
- Valve stem, hardened stainless.
- Packing, special Marsh "Marpak" moulded ring.
- Fine stem threads for strength and precision throttling.
- Deep inlet and outlet thread chambers.
- Bodies marked in accordance with MSS regulations.

Maximum Working Pressure 10,000 P.S.I.

Water, oil, gas or corrosive fluids not injurious to 416 stainless steel.

MARSH

"THE STANDARD OF ACCURACY"

Keep yourself up to date . . .

To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here →

New free bulletins are listed and numbered, beginning on back of this page. To order those you want, write POWER item number here — *do not use manufacturer's bulletin number.* →

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your request to the various companies, they'll send the info

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before Nov. 1, 1956. Void after this date. 7/56

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before Nov. 1, 1956. Void after this date. 7/56

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before Nov. 1, 1956. Void after this date. 7/56

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

This Month's FREE Literature

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 2¢ STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

MECHANICAL TRANSMISSION

1 **Power take-offs** for internal-combustion engines up to 600 hp are discussed in illustrated 8-p bulletin 308. Contains full specs, installation dimensions, driving ring dimensions. Twin Disc Clutch Co, Racine, Wis.

2 **Couplings.** Fixed-bore, chain, flexible and rigid units are described in illustrated 8-p bulletin V-169-E. Contains full specs, rating and selection charts. Browning Manufacturing Co. Maysville, Ky.

3 **Electrical brakes** and clutches are subject of 8-p bulletin WEB 6212. Included are full specs for primary electric brakes, clutches and clutch-brakes; fractional-hp *RF* electric brakes, *SF* electric clutches and clutch-couplings; and integral-hp electric brakes and clutches. Warner Electric Brake & Clutch Co, Beloit, Wis.

4 **Reduction gears,** high-speed, for mechanical-drive steam turbines are described in 4-p bulletin DB 1165. Capacities range from 50 to 5000 hp. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

5 **Flexible couplings,** variable-speed pulleys and transmissions, universal joints and motor bases are described in 12-p illustrated bulletin 1200. Includes operating data, hp ratings, sizes and types of equipments. Lovejoy Flexible Coupling Co, Dept PRN, 4800 W Lake St, Chicago 44, Ill.

PIPING, VALVES, SPECIALTIES

6 **Pvc pipe and fittings.** Bulletin TD-119 gives description, advantages and applications of a normal-impact grade and a high-impact grade of unplasticized polyvinyl chloride pipe and fittings. The Carpenter Steel Co, Alloy Tube Division, Union, N. J.

7 **Stainless steel pipe.** Bulletin TB-410 deals with use of seamless and welded stainless steel pipe and stainless steel welding fittings in the process industry where corrosion and/or elevated temperatures are determining factors. The Babcock & Wilcox Co, Tubular Products Division, Beaver Falls, Pa.

8 **Hydromatic valve** used in control of demineralizers, zeolite softeners, dealkalizers and pressure filters is described in bulletin 5813. Unit can be operated automatically or manually. Cochrane Corp, Philadelphia 32, Pa.

9 **Flexible pipe nipples** for connecting air or gas lines to industrial oil or gas burners are subject of 4-p bulletin 708B. Contains photos, diagrams, full specs and selection chart. Hauck Manufacturing Co, 124-136 10th St, Brooklyn, N. Y. (*Continued on page* 210)

WHICH CRUSHER CRUSHES THE MOST COAL USING THE LEAST POWER?

FIG. 1

FIG. 2

In conventional Ring Hammermills each crushing ring is hung on a Suspension Bar. Fig. 1 above shows position of ring when rotor is not in motion. Fig. 2 shows position of ring when rotor is in motion. Centrifugal force pulls ring beyond rotor circle.

Look at Fig. 3 and see what happens when ring strikes coal as it passes through the crusher. Force of coal pushes ring back almost beyond perimeter of rotor, thus only a minimum of crushing action is applied to coal by ring. Higher speed of rotor is required to hold rings in deep contact with coal stream. Result—more power is required and crushing force is not constant or uniform.

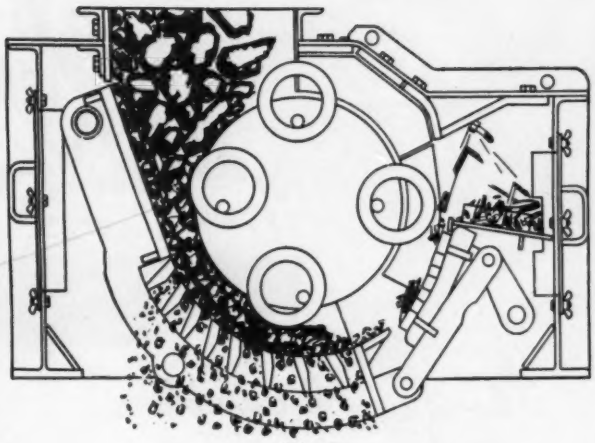


FIG. 3

SEE HOW PENNSYLVANIA OVERCOMES THIS WEAKNESS OF RING HAMMERMILLS

FIG. 4

FIG. 5

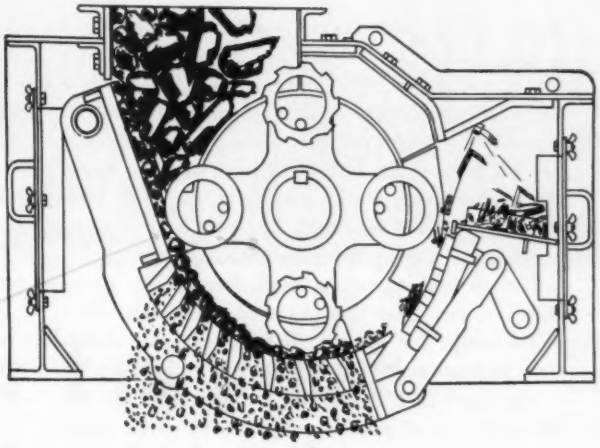


FIG. 6

The rings in the Pennsylvania Coal Granulator are hung on *two* Suspension Bars. Note placement of second bar (B) in Fig. 4 above which shows position of rings when rotor is not in motion. Fig. 5 above shows position of rings when rotor is in motion and machine is running empty.

NOW COMPARE THE POSITION OF the rings in the Pennsylvania Coal Granulator when machine is running and a stream of coal is passing through the crusher (Fig. 6) with the position of rings in a conventional ring hammermill (Fig. 3). In the Pennsylvania Granulator, when the coal comes in contact with the ring and starts to force the ring back, the ring encounters bar "B," which holds the ring in deep contact with the coal, and the ring rolls over the coal with a constant effective crushing action.

This is the patented feature that gives greater machine capacity at slower rotor speed.

YOU CAN'T GET THIS ACTION IN ANY OTHER CRUSHER

PENNSYLVANIA

COAL GRANULATORS

PENNSYLVANIA CRUSHER DIVISION
Bath Iron Works Corporation
West Chester, Penna.

PE-241

George Edwards

gives a thought to the distaff side

► IT GOES WITHOUT SAYING that every woman wants her husband to be admired and respected by other people. The dreamy-eyed bride sees herself in a lovely modern home with pushbutton control of almost everything except the kids. She sees herself driving to meet the 5:15 train from the city. Picking up her executive husband with his important-looking brief case, she feels admiring eyes on them as they drive away from the station.

There's nothing wrong with dreams like these. Not a thing. Ambition, handled right, is a *must* in the recipe for success. But there's a big difference between ambition and wishful thinking.

The hard fact is that the recipe also calls for liberal dashes of sacrifice. Since most of us aren't born with silver spoons in our mouths, the business of getting an education gives the average young man a fairly good taste of sacrifice before he gets out of school.

After he's married, he naturally wants to be home with his family at the end of the day. And so it goes for the first few years. Then things may begin to change. His boss, being a pretty sharp guy—which is why he is the boss—recognizes ability when he sees it. He starts keeping an eye on this young fellow. You can be sure that, with a lot of other things, he sizes up the reaction to making personal sacrifices. He's been through it. He knows how much time and attention executives give to their work. Sacrifice of time with the family, social life, a basement-workshop project.

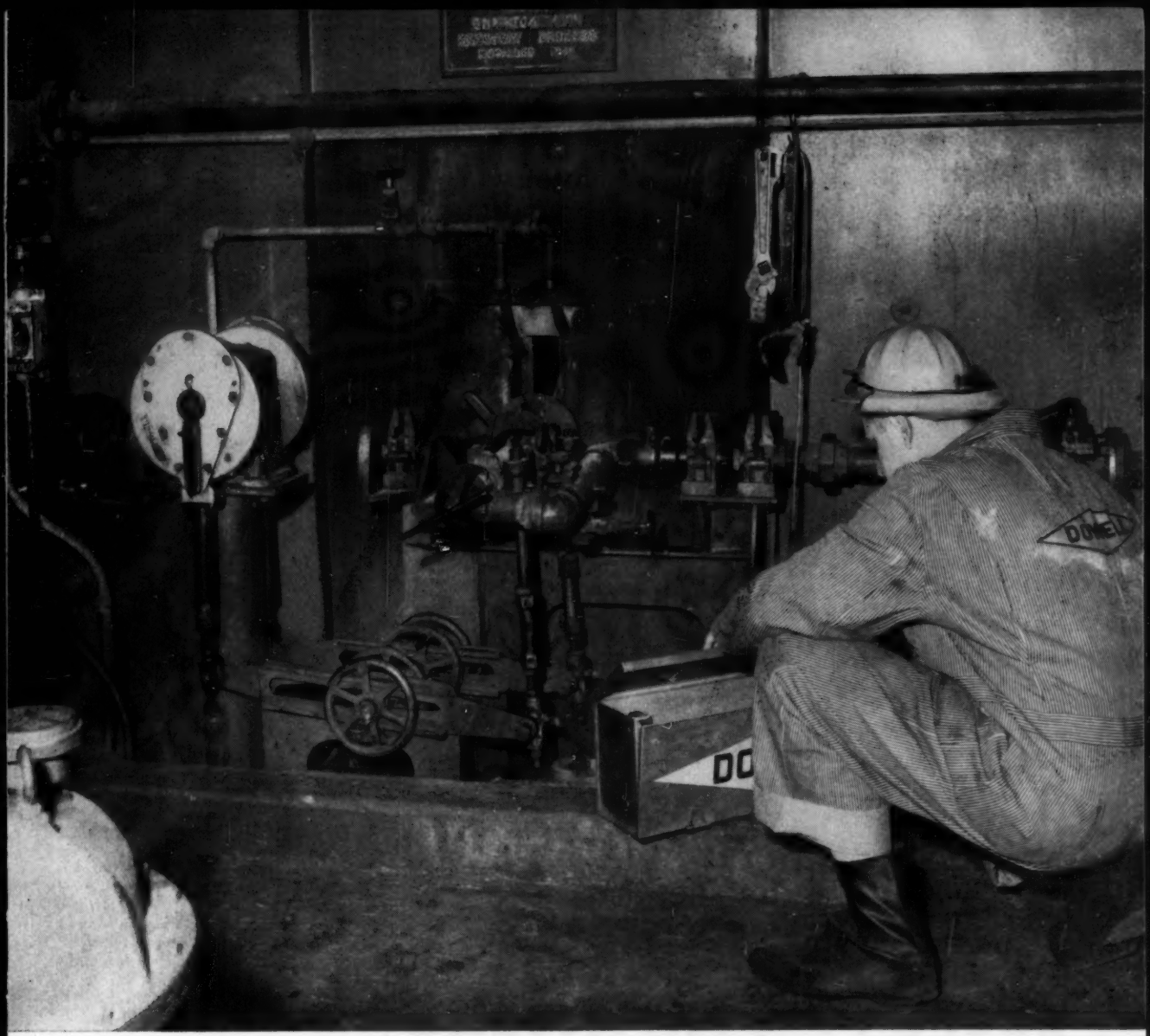
He knows it's no fun to grab some supper in town, then back to the office in the evening. Or to have to make a trip, missing an anniversary party, a show they planned to see, a week-end picnic he'd promised the kids.

It's no fun for his wife either when a phone call pulls the rug from under their plans for that evening. Even if nothing is planned, just not having him home can be pretty depressing. But the all-important thing is—he knows she understands. And she's well on the road to making her dreams come true in understanding, doing her part when the finger of opportunity points to her husband.

Moving up the ladder means more income, a nicer way of life. It means a day when meeting the 5:15 isn't a dream. But, meantime, moving up also means more responsibility, more demands on his time. For both of them, it means lots of self-denial. But it's an investment that always pays off.

The French police have a saying, *cherchez la femme*, which means *find the woman*. They reason that most crimes in one way or another involve a woman. Finding the woman often leads them to their man. This may be true in the criminal world. But in the world we know the basic logic is very sound in a far different sense. Perhaps some of us don't realize it, but back of every successful man you'll generally find a successful woman.

Wilson Mizner once said, "The gent who wakes up and finds himself successful hasn't been asleep." I'd add that his wife was probably wide-awake too.



The risk is too great —clean it right

You don't take risks when men, equipment, and lost production time are involved. That's why more and more companies are investigating the methods and firms used in their chemical cleaning. They know it's work for experts.

What are they concerned about?

First, they want to know they are getting the benefits of experience. These benefits include less downtime and more thorough cleaning. Dowell has this experience with over 15 years and 10,000 boilers alone to their credit. In saving downtime, Dowell often cleans equipment while it is in operation.

Next, these companies want to be sure their men and equipment have the greatest possible protection. Dowell excels here, too. For safety is foremost in the Dowell engineer's mind. Thoroughly trained, he uses only the latest safety methods and equipment. He works closely with your safety personnel to establish safest possible working procedures.

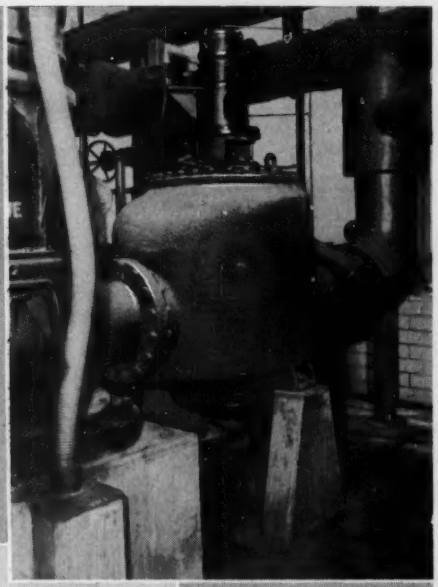
Be sure you are getting maximum results with maximum protection in your chemical cleaning.

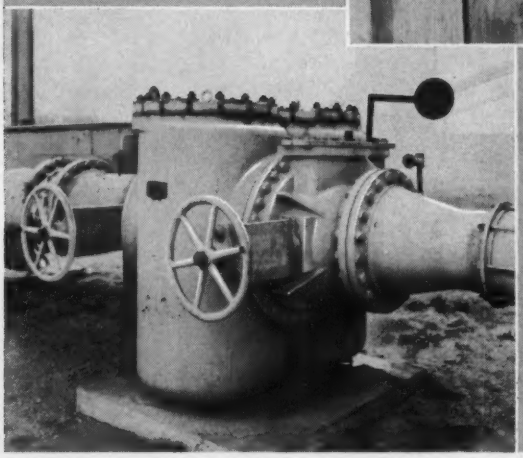
Call the Dowell office near you. Dowell engineers are ready to discuss and help you with your cleaning problems any time, at no obligation. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept. G-23.

chemical cleaning service for industry **DOWELL**

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Favorites of Power Stations Everywhere!





One of four Elliott 20-in self-cleaning strainers located at discharge side of vertical river-water pumps at a power station.

One of several Elliott twin strainers (installed outdoors) handling cooling water at a power station.

ELLIOTT STRAINERS

Power stations all over the country are utilizing sturdy, dependable Elliott Strainers like these. They provide a continuous liquid flow with no down-time for cleaning. The type "K" strainer (upper right) cleans itself constantly and automatically. The type "A" twin strainer (lower left) offers one compartment for cleaning while the other handles the flow. When your operations call for clean, trouble-free liquids, put an Elliott Strainer on the job—whether the installation is inside or outside. For details on these and other Elliott Strainers, contact your local Elliott representative or write Elliott Company, Accessories Dept., Jeannette, Pa.

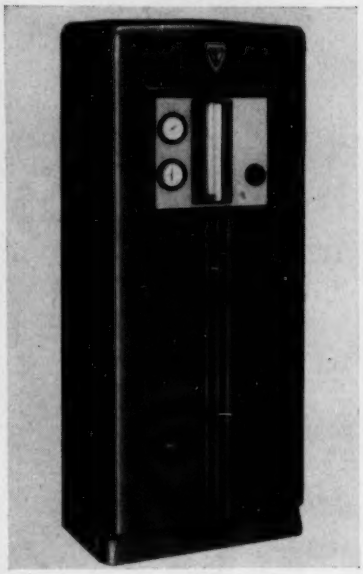
AS-1

ELLIOTT Company

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

More EQUIPMENT NEWS

Begins on page 154



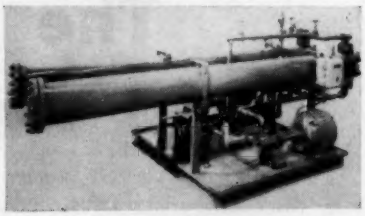
V-notch chlorinators

721 • These units are built entirely of corrosion-resistant materials, feature a V-notch variable-orifice metering and controlling principle.

The chlorinators cover a feed range from 25 to 2000 lb per 24 hours. *Series A-712* wide-range model features direct-reading dial indication of feed rate with ± 4% accuracy over a 20 to 1 range for any V-notch variable-orifice. *Series A-711* chlorinator provides a rotameter for feed rate indication, giving accuracy over a 10 to 1 range for any one rotameter. Technical bulletin available on request to the manufacturer.

Wallace & Tiernan Inc,
25 Main St, Belleville 9, N. J.

For more details on these items, use post cards p 163. Identify your request with item number.



Fuel-oil pump, heater sets

718 • Ready-to-operate fuel-oil pump and heater sets are designed to control pressure and viscosity of heavy industrial fuel oil for better combustion results. The units heat to 300 F, pump to 400 psi and handle capacities to 3000 gph. Single or duplex sets can be obtained for steam or electric drive and duplex "electro-steam" sets are available providing for electrical failure by incorporating one steam pump and one electric-motor-driven pump.

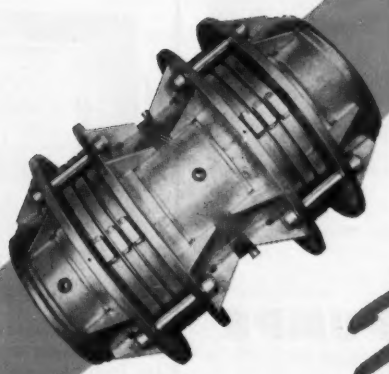
Accessories for accurate control and adjustment include suction and discharge pressure and temperature indicators, relief

LOOKING FOR AN "ALL PURPOSE" EXPANSION JOINT?

Zallea has never built one—never will. And for good reason. Like all precision engineered equipment, Zallea Expansion Joints are designed to fill specific rigid requirements. In every case, types, sizes and materials of construction are determined by factors of temperature, pressure, traverse and special service conditions.

Zallea Brothers design and build expansion joints for every requirement of modern industry. Field tests have proved the value of our emphasis on designing the expansion joint to fit the problem. Records show that Zallea Expansion Joints outlast all other packless expansion joints from 90% to as much as 1200%. Such reliability is further proof of Zallea design superiority.

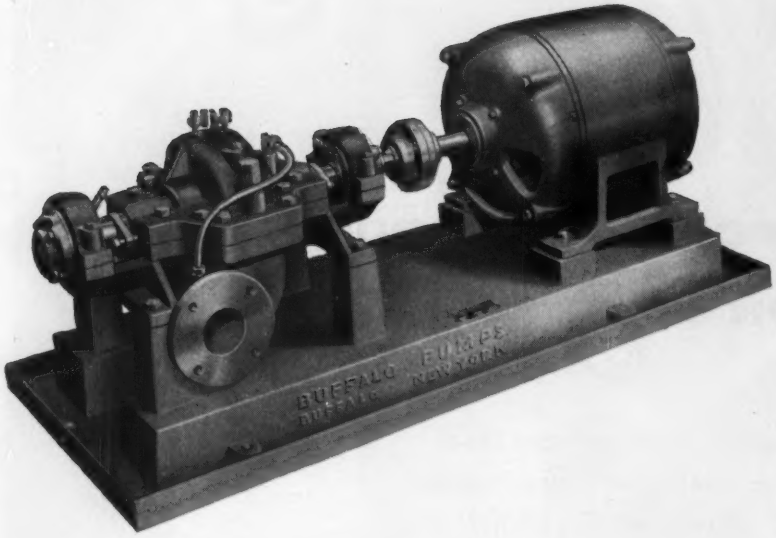
Zallea representatives are always ready to help solve problems relating to expansion joints. Or if you prefer, write for Bulletin 351 which describes the many standard types available.



Zallea expansion joints

ZALLEA BROTHERS, 814 LOCUST STREET, WILMINGTON 99, DELAWARE

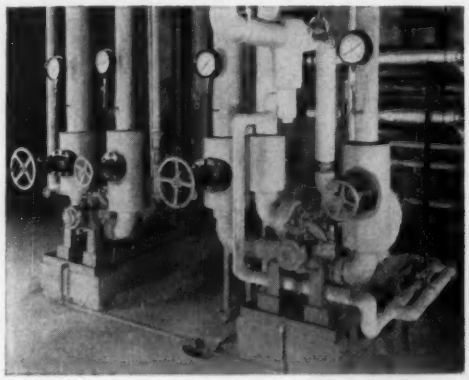
World's Largest Manufacturers of Expansion Joints



"BUFFALO" MULTISTAGE PUMPS

"MADE-TO-ORDER" for BOILER FEED!

These time-proved pumps are delivering clear water at high temperatures against pressures up to 500 psi — doing it efficiently and on a trouble-free basis. Consider a typical example — the 3″ 2-stage "Buffalo" RR Pump delivering 400 gpm against 500 ft. head at 3500 rpm — an efficiency of 75%. Yes, these pumps are made-to-order for your boiler feed or other high pressure jobs. Bulletin 980 gives you all the engineering details and "Q" Factor* features that add up to satisfaction when you specify "Buffalo" for the job. Write for your copy today!



"Buffalo" Type RR Pumps giving efficient performance day in and day out in a large boiler installation where continued high pressure is vital.

The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

"Buffalo" PUMPS

BUFFALO PUMPS

DIVISION OF BUFFALO FORGE CO.

488 Broadway Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

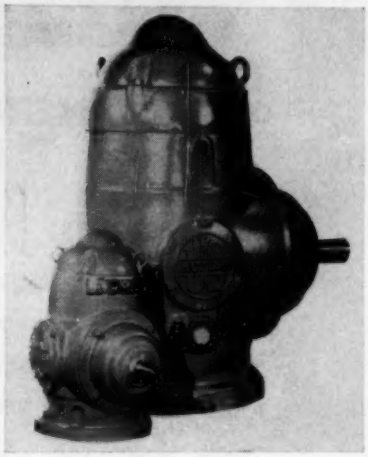
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

More EQUIPMENT NEWS

Begins on page 154

valves, oil suction and discharge strainers. A welded steel base is provided with complete assembly, piping and wiring.

Walter H Eagan Co, Inc, 2336 Fairmount Ave, Philadelphia, Pa.



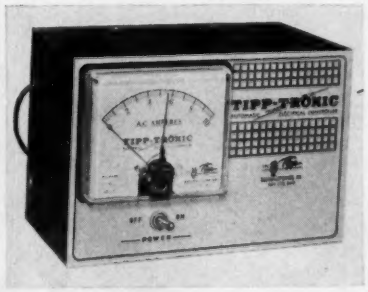
Right-angle gear drives

719 • Units are now available from 11 to 150 hp in a wide selection of gear ratios and speeds. They are universally adaptable to any vertical turbine pump and are driven by gas, gasoline or diesel engine.

Reverse protection clutch prevents damage to the pump and drive in event of accidental engine reversal. Castings are heat-treated to remove internal stresses and prevent distortion. Automatic oil circulation assures positive lubrication of all moving parts, according to manufacturer. Backstops are available to prevent backspinning of pump shaft when engine is stopped or clutch is disengaged. Request bulletin 1775 from the manufacturer.

U.S. Electrical Motors, Inc, Box 2058, Terminal Annex, Los Angeles 54, Calif.

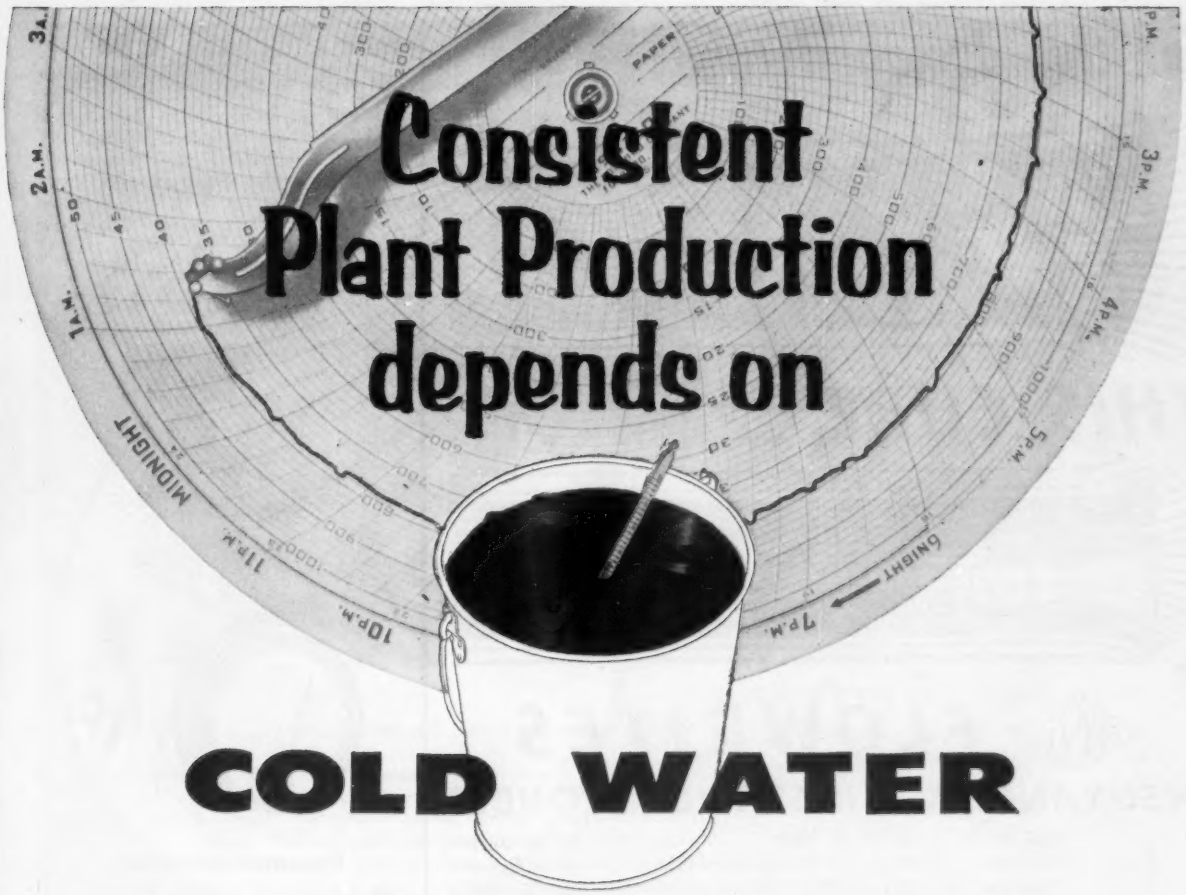
For more details on these items, use post cards p 163. Identify your request with item number.



Automatic safety controller

724 • This electro-mechanical device is said to provide warning and prevent damage from abnormal load conditions of any kind on electrically-driven conveyor systems. It eliminates need for shear pins, slip clutches and other mechanical safety devices often used on conveyors.

A self-contained package, the unit meas-

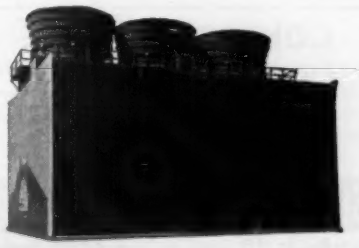


Consistent Plant Production depends on COLD WATER

Whether your end product is kilowatts, chemicals or candy, production is so closely aligned to consistent cold water temperature that your cooling tower is a most important element of plant equipment. This puts a premium on tower performance . . . and it points up Marley as the logical, economical selection for high-potential plants.

There are two major factors that qualify Marley industrial towers for critical cooling jobs: first, the initial performance is never in doubt; the cooling ability of every Marley tower is pre-determined. Fan, distribution, filling — every functional element — is pre-rated by the method developed by Marley's 35 years of specialized research and proved by scores of service tests.

Continuance of top-level tower performance is a single responsibility for Marley designs and manufactures every component of its towers. It's a responsibility that Marley completely and gladly accepts. To translate this policy into action and to assure long-continued performance at specified temperature level, qualified Marley Field Service Engineers observe and check large industrial towers at frequent intervals. Their training and practical experience in tower operation and maintenance assists owners and operators to maintain the consistent cooling service that means plus production and increased operating profit.



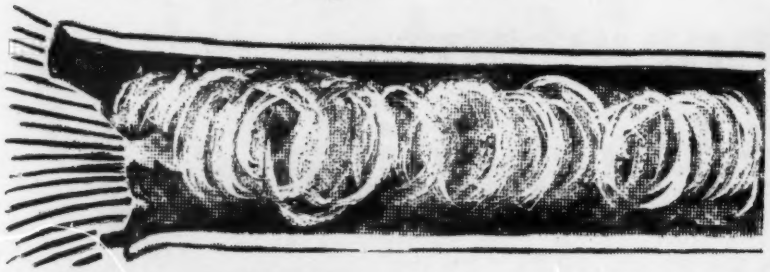
MARLEY

Founder Member Cooling Tower Institute

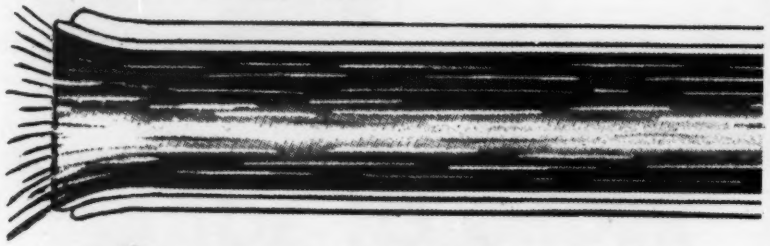
The Marley Company

Kansas City, Missouri

For this damaged tube...



THIS CURE



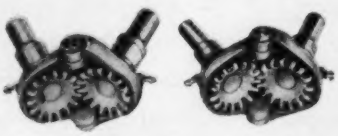
CONSECO FLOWRITES

INSURANCE AGAINST TUBE TROUBLE

Millions of times, in 25 years of service, under all conditions, FLOWRITES have proved they prevent tube end erosion. Conseco Flowrites are short molded nylon or metal tubes, inserted in the entrance end of condenser tubes. They are made of molded nylon or same metal as the tube itself. Eliminate gas and air pockets; prevent tube plugging; assure uninterrupted increased flow of water. Flowrites cost about 90% less than retubing; also prevent loss of revenue during plant shutdown. Flowrites are easy to install and repair, and are GUARANTEED. Write for special descriptive BULLETIN with M.I.T. Laboratory Report.

CONSECO UNIVERSAL GEAR BEVEL JOINTS

Solve shaft line-up problems; save on installation costs; reduce operating accidents. Positive transmission of torsion regardless of shaft angle, from 0° to 135° on vertical center line, or from 0° to 360° on horizontal center line. Capacity 1580 to 4938 inch pounds at 49 rpm.



Five standard sizes for shaft diameters of ½", ¾", 1", 1¼", and 1½". Special shaft lengths to order.

Other specialties include: *coils for feed water heaters and evaporators, Conco cleaning guns and plugs, condenser ferrules, detectaleak tube testers, fibre plugs, metallic and fibre packing for condensers, Wizard condenser injectors, etc.*

• WRITE US FOR SPECIAL BULLETINS •

CONSECO SERVICE

Conseco Service for repair or maintenance of any type or make of tubular equipment is at your service any day, any hour, Sundays, holidays anywhere in the country. Just wire or 'phone our Service Department.

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

164 OBSERVER HIGHWAY
HOBOKEN, N. J.

More EQUIPMENT NEWS

Begins on page 154

ures and acts upon variations from normal load over a wide range. It instantly and automatically shuts off the conveyor system at any predetermined load setting. It may also be set up to give warning or alarm of impending trouble before the shutoff stage is reached.

Tipp Manufacturing Co,
Tipp City, Ohio

Pressure control valve

728 • *Type 3381* pressure reducing and regulating valve is only 5⅝ in. high and 2⅝ in. face to face. It provides accurate pressure control of air, water, oil, steam and most liquids and gases. Body and trim are bronze, seat and diaphragm are bronze or composition. Sizes are ¼ and ⅜ in. with screwed ends.

The valve can operate at inlet pressures to 400 psi at 150 F and 250 psi at 400 F. Fire spring ranges are available from 5 to 300 psi delivery pressure.

The unit can be supplied with a pressure gage mounted in either of the two outlet connections. For more information request bulletin 948 from manufacturer.

A W Cash Co, Box 551
Decatur, Ill.

For more details on these items, use post cards p 163. Identify your request with item number.

Flyash collector—draft unit

725 • Packaged unit combines a regenerative flyash collector and induced draft fan. Collector section removes flyash, soot and cinders from stack gases and fan section provides draft for boiler operation.

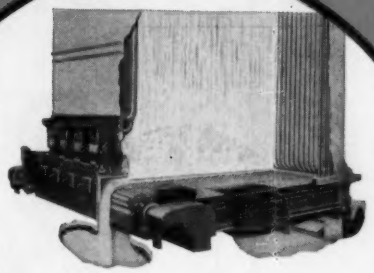
Low draft loss of the regenerative collector keeps fan speed and power requirements low, while high-collection efficiency keeps stack discharge clean under all operating conditions, according to manufacturer. Combining the collector and fan in a single unit simplifies installation, cuts cost.

These units can be used for new boilers where they provide all the draft required; or with existing boilers that require dust

USE DETROIT SPREADER STOKERS TO BURN SOLID FUELS WITHOUT EXPENSIVE PREPARATION

DETROIT ROTOGRATE • ROTOSTOKER • ROTOSTOKER (TYPE C-C)
HIGH ECONOMY AND AVAILABILITY • LOW MAINTENANCE

1



DETROIT ROTOGRATE

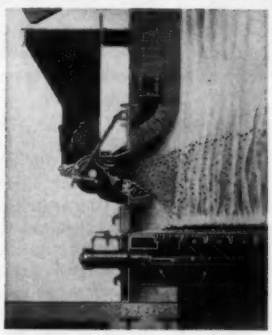
Original spreader stoker with forward moving grates that discharge the ash at the front. Our long experience has contributed to many exclusive refinements and features of design. Proven superiority with hundreds installed here and abroad. For capacities up to approximately 400,000 pounds of steam per hour.

Detroit Stokers burn any Bituminous Coal or Lignite without special preparation. Commercial sizes ranging from 3/8" x 0" to 1¼" x 0" are ordinarily used. High burning rates without clinkering difficulties. Also many refuse fuels including wet bark, hogged wood, bagasse, etc. are burned separately or in combination with coal; efficiently and without smoke.

Widely fluctuating loads are easily handled. Parasite power is negligible. High overall efficiencies at all capacities are assured. Maximum availability and very low maintenance.

Buy "Detroit"—They are "the most".

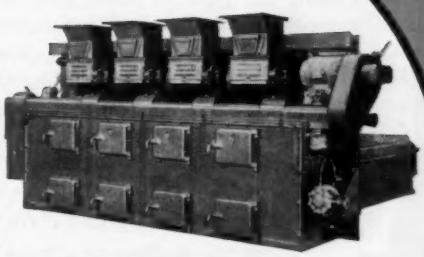
2



DETROIT ROTOSTOKER

For small and medium size units. Power Dumping, Hand Dumping or Stationary grates to fit the furnace provide desired capacity under full automatic control.

3



DETROIT ROTOSTOKER (TYPE C-C)

Continuous cleaning type particularly suited to highly fluctuating loads. Many sizes for capacities of 5,000 to 75,000 pounds of steam per hour. Reciprocating grates discharge ash at front. No basement is required.

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN
Works at Monroe, Michigan: District Offices in Principal Cities

WRITE FOR BULLETINS ON THESE MONEY SAVING STOKERS

KIRK & BLUM

SHEET and PLATE FABRICATION for POWER PLANTS

Whatever your requirements in sheet and plate fabrication . . . such as the mammoth breeching section shown here . . . call on KIRK & BLUM.

During the past 50 years, Kirk & Blum has acquired exceptional experience and complete facilities for fabricating carbon steel, stainless, aluminum, monel and other alloys up to ½" thickness.

Send prints for prompt quotations on your requirements, or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication Booklet.

- BREECHINGS • STACKS • AIR and GAS DUCTS
- CASINGS • LOUVERS • BINS and HOPPERS
- INSULATION JACKETING
- ALUMINUM and ALLOY FABRICATION
- CONTROL PANELS and DESKS

THE KIRK & BLUM MFG. CO.

3233 Forrer Street, Cincinnati 9, Ohio

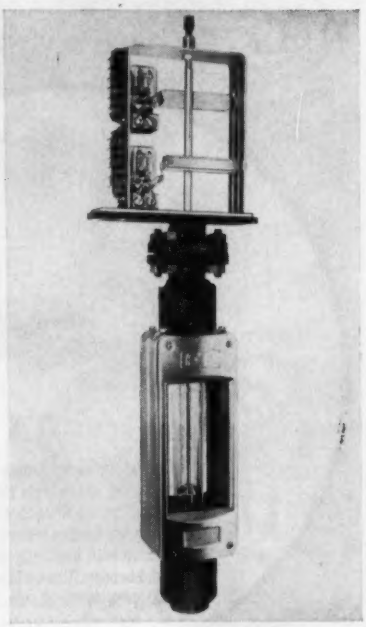
More EQUIPMENT NEWS

Begins on page 154

collection and increased draft to improve performance or to handle greater loads.

A full range of capacities are available in a number of different physical arrangements to fit different space conditions.

Breslove Separator Co, Commonwealth Bldg, Pittsburgh 22, Pa.



Vibration-proof flow alarm

727 • Unit uses two snap-action electrical contacts, hermetically sealed in a glass tube, which are drawn together to set off the alarm by passage of a magnetic float-extension rod.

The switch can be positioned in the mounting frame either above or below the magnet in the float-extension rod to give a signal for either high or low limits of flow. One switch can be set above and another below the magnet to give both high and low alarms. Multiple alarms may be incorporated for special applications.

An important use for the flow alarm is in water or oil-cooling lines for large machines. It may be connected to a light or buzzer or both, or may be used to start a pump, close a valve, shut down the system or perform other on-off control functions.

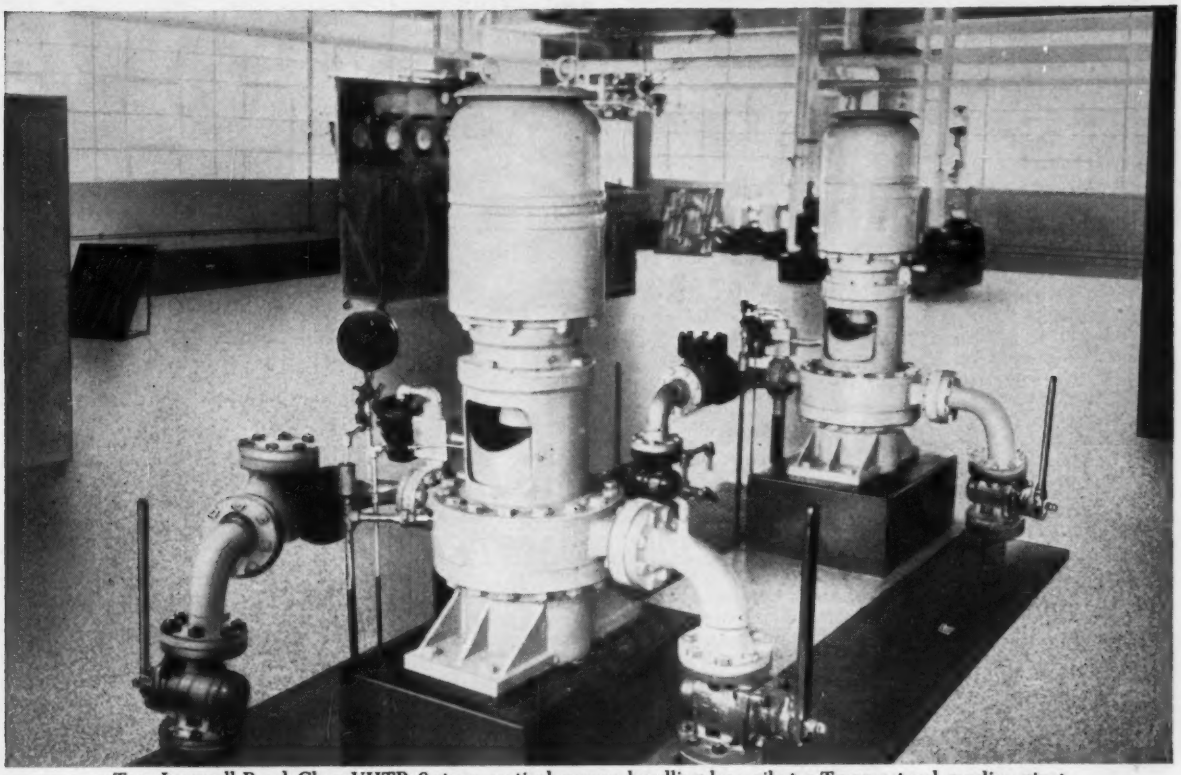
Fischer & Porter Company, 553 Jacksonville Rd, Hatboro, Pa.

For more details on these items, use post cards p 163. Identify your request with item number.

Pipe sealing compound

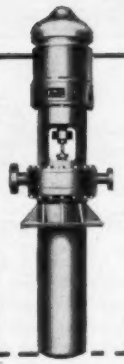
720 • Chemically-inert pipe joint compound claimed to positively seal practically all corrosive liquids and solvents has been developed for services to 212 F. Its base is *DuPont* Teflon, a material that is reportedly impervious to all types of hard-to-handle fluids and which possesses an extremely low coefficient of friction. The latter reduces wrench torque, permits con-

VERTICAL PUMPS



Two Ingersoll-Rand Class VHTB 6-stage vertical pumps handling lean oil at a Texas natural gasoline plant.

to lower your pumping costs



CLASS VHTB
Pressures: to 1500 psi
Capacities: 25 to 325 gpm
Temperatures: to 750°F.

Vertical, multi-stage diffusor-type unit. Single-suction impellers mounted back-to-back for axial hydraulic balance. Stuffing box under suction pressure.

For low capacities at high heads on process, boiler feed, hydraulic and similar applications.

CLASS VP
Pressures: to 750 psi
Capacities: 10 to 350 gpm
Temperatures: to 750°F.

Vertical, multi-stage, diffusor-type construction. Single-suction impellers with throttling sleeve balancing device to reduce axial thrust and provide suction pressure at stuffing box. Entire pumping element removable without disturbing suction and discharge piping.

For low capacities at medium high heads on applications such as process, boiler feed, and heater drain work.

Designed specifically for low-capacity high-head applications, these Ingersoll-Rand vertical process pumps are engineered with a background of process pump experience. They are manufactured in the most modern of pump plants to deliver years of efficient service with a minimum of down time and maintenance expense.

Features include: "Double-Case" construction with segmented diffusor-type inner casing for complete radial hydraulic balance and minimum bearing wear... Positive aligning feature for perfect positioning of inner casing segments... Rotor assembled without prestressing shaft to eliminate all possibility of shaft distortion. Available in bronze fitted, all iron, carbon steel, and stainless fitted materials to cover a wide range of process services.

Ask the Ingersoll-Rand engineer to show you these and other features which make Ingersoll-Rand pumps your best bet for low cost year-in, year-out service.

Ingersoll-Rand

10-376 **11 BROADWAY, NEW YORK 4, N.Y.**

COMPRESSORS • GAS & DIESEL ENGINES • AIR & ELECTRIC TOOLS • CONDENSERS • PUMPS • ROCK DRILLS • VACUUM EQUIPMENT

Tips on TACHOMETERS *for* MECHANICAL ENGINEERS

Longer Instrument Life
Lower Repair Bills

Both models AO and DO Jagabi Hand Tachometers with "Overspeed Protection" are available at James G. Biddle Co. These highly available and always reliable instruments are equipped with a special friction coupling that minimizes the damaging abuse of occasional overspeeding and too-sudden acceleration if accidentally used at too-low range setting. This protection is also available in the Jagabi Tachograph.

JAGABI®
HAND TACHOMETERS
with Automatic Overspeed Protection

Write for **BULLETIN 35-01-P**

FAMOUS Dr. HORN *HAND TACHOMETER*

Many consider Dr. Horn to be the finest speed measuring device obtainable. Gives instantaneous readings of rotational—or linear and peripheral speeds—regardless of the direction of rotation. Measures 6 ranges from 25 rpm to 30,000 rpm. Operates with equal precision in vertical, horizontal or slanting position. Simple mechanism. Overspeed protection. Low maintenance. Long life. James G. Biddle Co. is sole U.S. distributor.

Write for **BULLETIN 35-65-P**

TWO-IN-ONE JAGABI® TACHOSCOPE

Combines speed indicator and stop watch. Replaces "human element" of error in starting and stopping with higher accuracy of calculation because Tachoscope can be operated for longer period. High precision instrument for measuring machine speeds up to 20,000 rpm. Frequently used as a standard for checking other speed measuring instruments. The high quality stop watch may also be used independently.

SPEED MEASURING BULLETIN. A selection chart of Speed Measuring Instruments for specific conditions is a feature of BULLETIN 35-P.

JAMES G. BIDDLE CO.

ELECTRICAL TESTING INSTRUMENTS
•
SPEED MEASURING INSTRUMENTS
•
LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET, PHILADELPHIA 7, PA.

James G. Biddle Co.
1316 Arch St., Phila. 7, Pa.

Gentlemen:
Please send me material checked:

☐ 35-01-P ☐ 35-65-P ☐ 35-P

NAME

JOB FUNCTION

COMPANY

ADDRESS

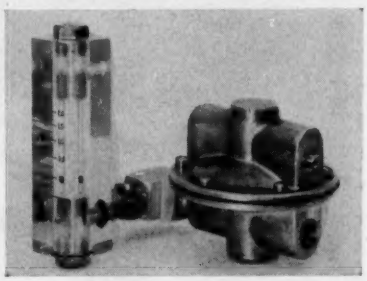
More EQUIPMENT NEWS

Begins on page 154

nections to be drawn tighter without undue stress or strain.

The non-adhesive quality of Teflon and the non-hardening characteristics of the compound allow connections to be easily disassembled, even after years of service, according to manufacturer. The compound is particularly adaptable for use on aluminum, stainless, monel or plastic pipe and is available in 2-oz screw-type jars.

Crane Packing Co, Dept PRN, 6400 Oakton St, Morton Grove, Ill.



Differential regulator with integral needle valve

729 • *Model H-21F* differential relay can be used for purging with air, water or gas in services where actual flow measurement is unnecessary. It can also be supplied in combination with a small flow-rate indicator as a complete purge meter package. Ranges from 0.2 to 2.0 scfh of air and 20 to 200 cc/min of water are available.

Conoflow Corporation, 2100 Arch St, Philadelphia, Pa.

For more details on these items, use post cards p 163. Identify your request with item number.

Superheater-heat interchanger

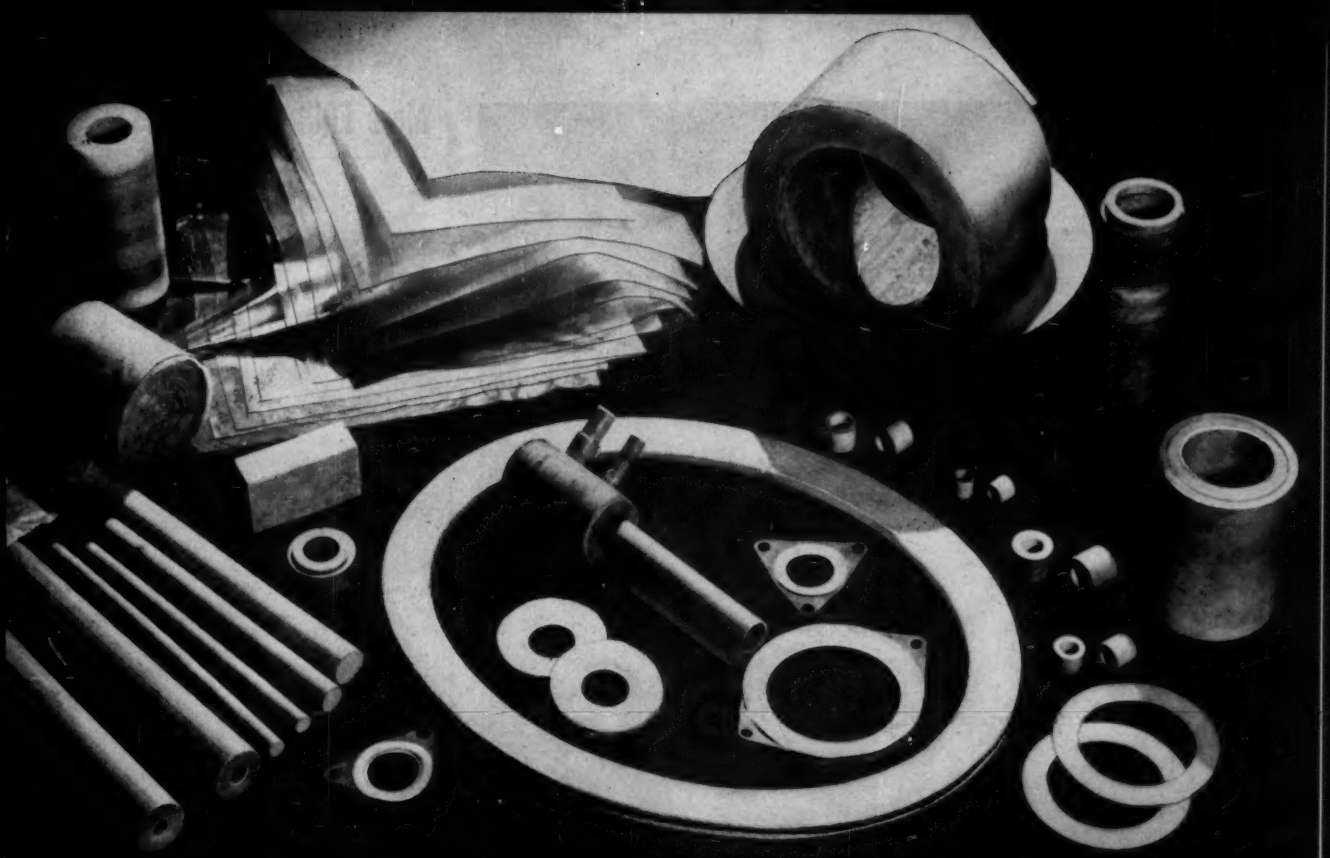
730 • Units are designed for use on air-conditioning and refrigeration systems to insure full utilization of evaporator surface and eliminate problem of having part of surface being used for superheating the refrigerant. Combining a superheater with a heat exchanger, the unit sub-cools the liquid refrigerant—thereby improving expansion valve operation and increasing efficiency of evaporator due to reduction in amount of flash gas. Complete specs on units in capacities from 1 through 100 tons are contained in descriptive bulletin obtainable on request to the manufacturer.

Heat-X, Inc, Brewster, N. Y.

Welded turbine rotors

726 • All-steel welded turbine rotors are claimed by manufacturer to be one of the safest on the market.

The buckets are of nickel steel, precision welded to the periphery of the rotor and capped by a steel shroud, also



ANKLON

Highly Resistant to Acids . . Solvents . . Alkalies

DISTRICT OFFICES

BALTIMORE, MD.	MILWAUKEE, WIS.
BOSTON, MASS.	MONTREAL, CANADA
BUFFALO, N. Y.	NEW ORLEANS, LA.
CINCINNATI, OHIO	NEW YORK, N. Y.
CHICAGO, ILL.	PHILADELPHIA, PA.
CLEVELAND, OHIO	PITTSBURGH, PA.
DAYTON, OHIO	SAN FRANCISCO, CAL.
DETROIT, MICH.	SEATTLE, WASH.
HOUSTON, TEX.	SPOKANE, WASH.
INDIANAPOLIS, IND.	ST. LOUIS, MO.
LOS ANGELES, CAL.	TOLEDO, OHIO

WILMINGTON, CAL.

Where temperatures range from Minus 90°F. to 500°F. ANKLON is your answer!

ANKLON is made from du Pont's Teflon. Due to its chemical inertness and its ability to resist the destructive action of the mineral acids, organic solvents and alkalies, it is finding many uses in packing and gasket applications.

The illustration shows gaskets fabricated from sheet, machined packing rings and molded packing rings made from Teflon.

Anklon is widely used in the chemical, petroleum, refining, food, electrical, power and maritime industries.

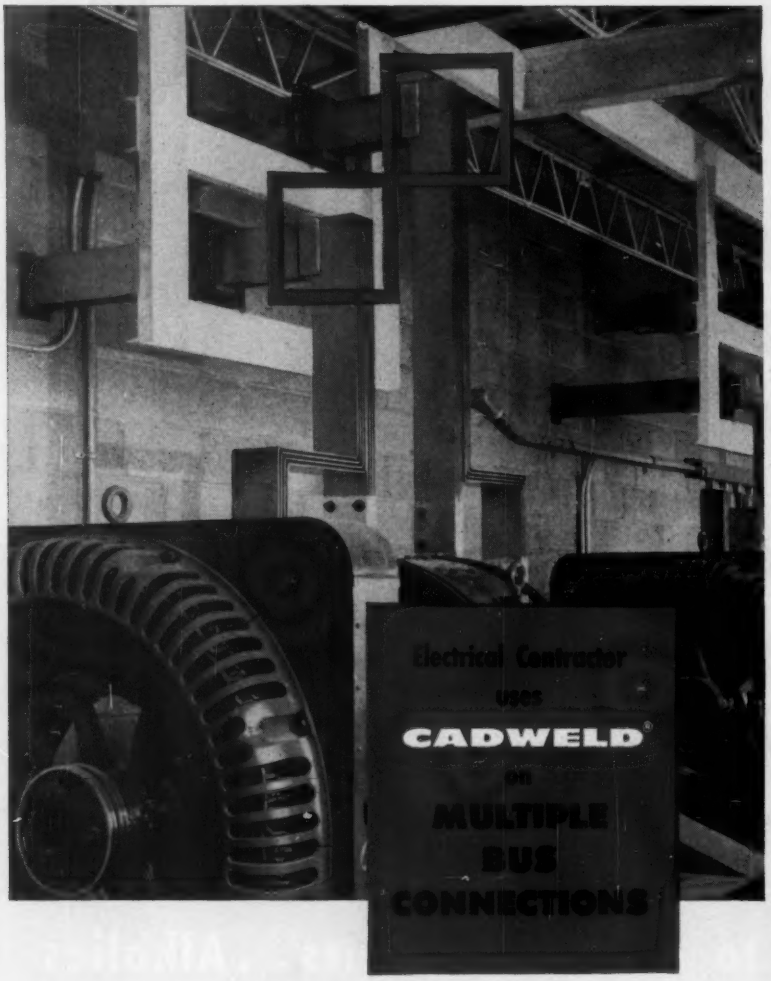
For specfic uses, contact our Engineering Department.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.

FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE



Carlson Electric Co., Youngstown, Ohio used CADWELD Electrical Connections on three large multiple bus installations during 1955.

According to Mr. William P. Burkey, Carlson's Chief Engineer;

1. **CADWELD Connections reduce the labor cost.**
2. **CADWELD Connections result in a superior electrical installation that cannot loosen or corrode and is maintenance free.**

Jobs involved various sizes and number of bus, ranging from a splice of ¼" x 2" bus up to a splice of eight ¼" x 6" bus.

Before figuring your next bus installation, investigate **CADWELD.**

CADWELD®

Erico Products, Inc.

2070 E. 61st Place · Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario

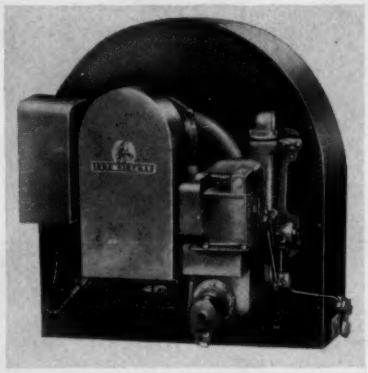
More EQUIPMENT NEWS

Begins on page 154

welded. Should a turbine lose its load, accompanied by governor failure, instead of speeding up to destruction, the buckets would be released from the rotor at the weld, thus removing the steam impingement forces on the rotor.

Speed at which the buckets will disengage is several times the maximum operating speed of the turbine but well below the rotor's breaking point.

L J Wing Mfg Co, Linden, N. J.



Rotary oil burners

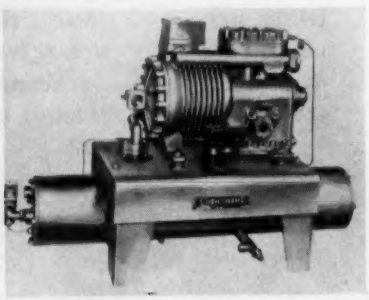
722 • Series of rotary oil burners, with integral air registers, range in size from 9 to 125 gph. The burners will fire with No. 6 or lighter oil and are designed for either natural or induced draft with approximately .10 to .15 in. WC required for full rating.

Integral air registers reportedly assure maximum combustion efficiency over a wide firing range. Combustion air is introduced through the firing port, facilitating thorough mixing of oil and air and cutting excess air to a minimum.

Electronic safety controls automatically shut off burner if an unsafe condition arises. A programming control sets up proper sequence of operations in stopping and starting the burner.

Iron Fireman Mfg Co, Cleveland 11, Ohio

For more details on these items, use post cards p 163. Identify your request with item number.

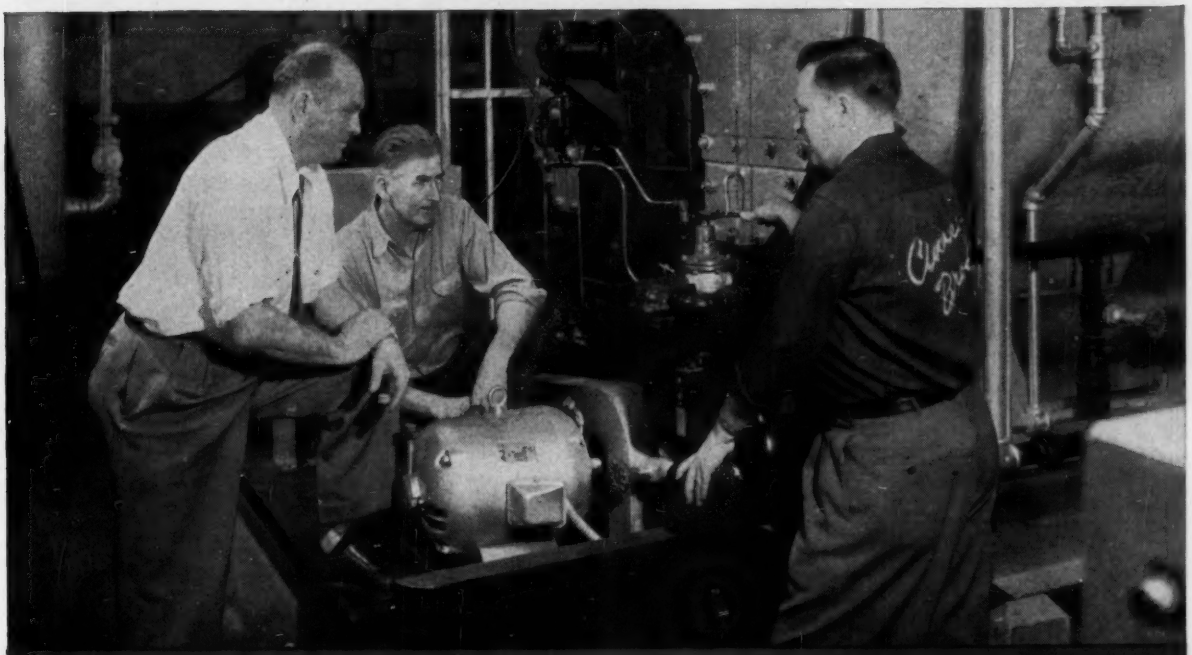


10-hp condensing unit

723 • Unit is designed for air-conditioning and other high-suction pressure applications. Heart of the unit is a 10-hp motor-compressor. The condenser is water-

A good start is a sure way

to maintain highest boiler efficiency



Cleaver-Brooks factory-trained servicemen instruct your operating personnel and adjust your boiler for peak efficiency. This service doesn't cost you a cent.

OTTO POLZIN is a typical Cleaver-Brooks factory-trained serviceman. He is shown on the job at Oilgear Co., Milwaukee, where he has just given two 125-hp Cleaver-Brooks boilers an initial start. Norbert Husting and Gordon Knischke of Oilgear are getting all the details on boiler operation and maintenance, including boiler blow-down procedure and tube cleaning.

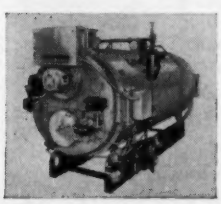
While on his "starting service call", Otto covered all of 32 items on his check list — such as the entire lubrication system, a CO_2 reading, inspected and cleaned relay points. In short, he *personally* made sure both boilers were "tuned" to perfection!

Cleaver-Brooks service is nationwide

This service is "standard practice" everytime a Cleaver-Brooks boiler is put into operation. And, as thousands of owners know, a phone call to your local Cleaver-Brooks representative brings this and other specialized services when needed.

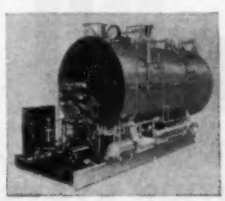
Factory-supervised starting is just one of many advantages of being a Cleaver-Brooks boiler owner. You get the ultimate in modern boiler design: forced draft with four-pass construction, hinged or davited front and rear doors for fast cleaning, 10-second gas or oil interchange — just to name a few features.

Get the full story on the complete line — sizes from 15 to 600 hp; 15 to 250 psi. Call your nearby Cleaver-Brooks representative or write direct. Cleaver-Brooks Company, Dept. H, 301 E. Keefe Ave., Milwaukee 12, Wisconsin, U.S.A. Cable Address: CEEBEEWEST — all codes. Ask for catalog AD-137.



MODEL CB — Most silent-running boiler on the market. Ideal for schools, hospitals. Sizes: 15 to 150 hp.

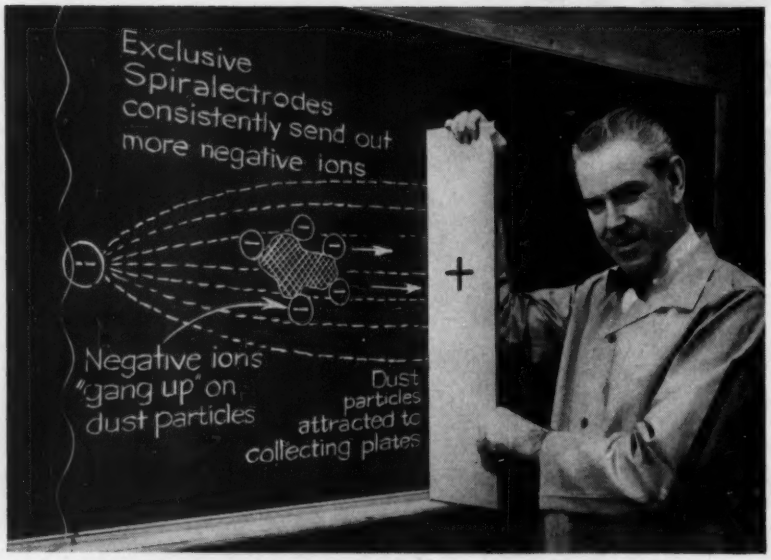
MODEL LR — Standard of the industry for steam or hot water service in heating or processing applications. Sizes: 200 to 600 hp.

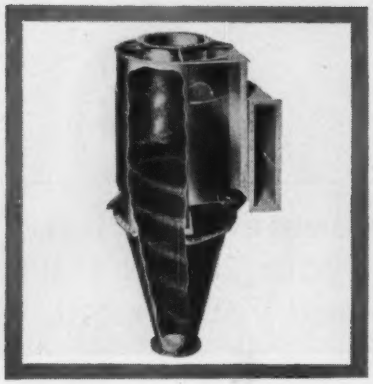


Cleaver-Brooks®

TWENTY-FIVE YEARS OF LEADERSHIP
BY THE ORIGINATORS OF THE SELF-CONTAINED BOILER

How a Buell Collection System "gangs-up" on dust to meet the toughest air pollution codes

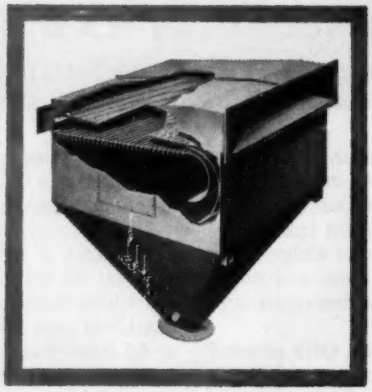




With positive gas flow control for peak efficiency . . . plus continuous cycle rapping to completely eliminate puffing . . . Buell's "SF" Electric Precipitator "gangs-up" on dust (even dust with high resistivity) to permit full production even under the most rigid anti-air-pollution codes.

Buell Cyclones also deliver extra collection efficiency to "gang-up" on dust: Exclusive Shave-off design harnesses double-eddy current and really puts it to work.

Buell's Low Resistance Fly Ash Collector combines high efficiency to meet present day strictness, with low draft loss for natural or mechanical draft installations.



FOR THE COMPLETE STORY
Write:
Buell Engineering Company
Dept. 50-G, 70 Pine Street
New York 5, New York

buell®

MECHANICAL ELECTRICAL

Experts at delivering Extra Efficiency in
DUST COLLECTION SYSTEMS

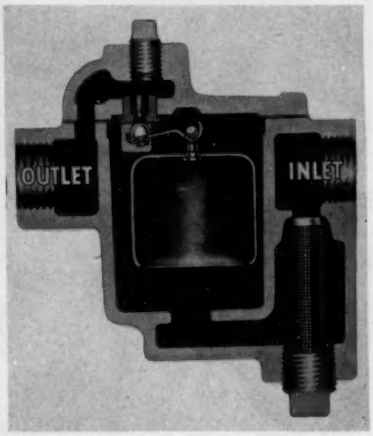
More EQUIPMENT NEWS

Begins on page 154

cooled shell and tube type and design of condensing unit permits either packaged or remote installation.

Fully assembled, the unit measures 31⅜ in. high, 20 in. deep and 53 in. long, including condenser water-inlet connection. The condenser-receiver can be easily hooked up in a cooling-tower installation.

Copeland Refrigeration Corp,
Sidney, Ohio



Combination strainer traps

731 • Strainer traps offer positive removal of all condensate plus a built-in strainer for protection of equipment. The cast semi-steel units are designed for pressures to 250 psi and temperatures to 450 F. Seats and disks are made of a heat-treated stainless steel said to be resistant to corrosion, wire drawing, cutting. Units have horizontal inlet and outlet connections.

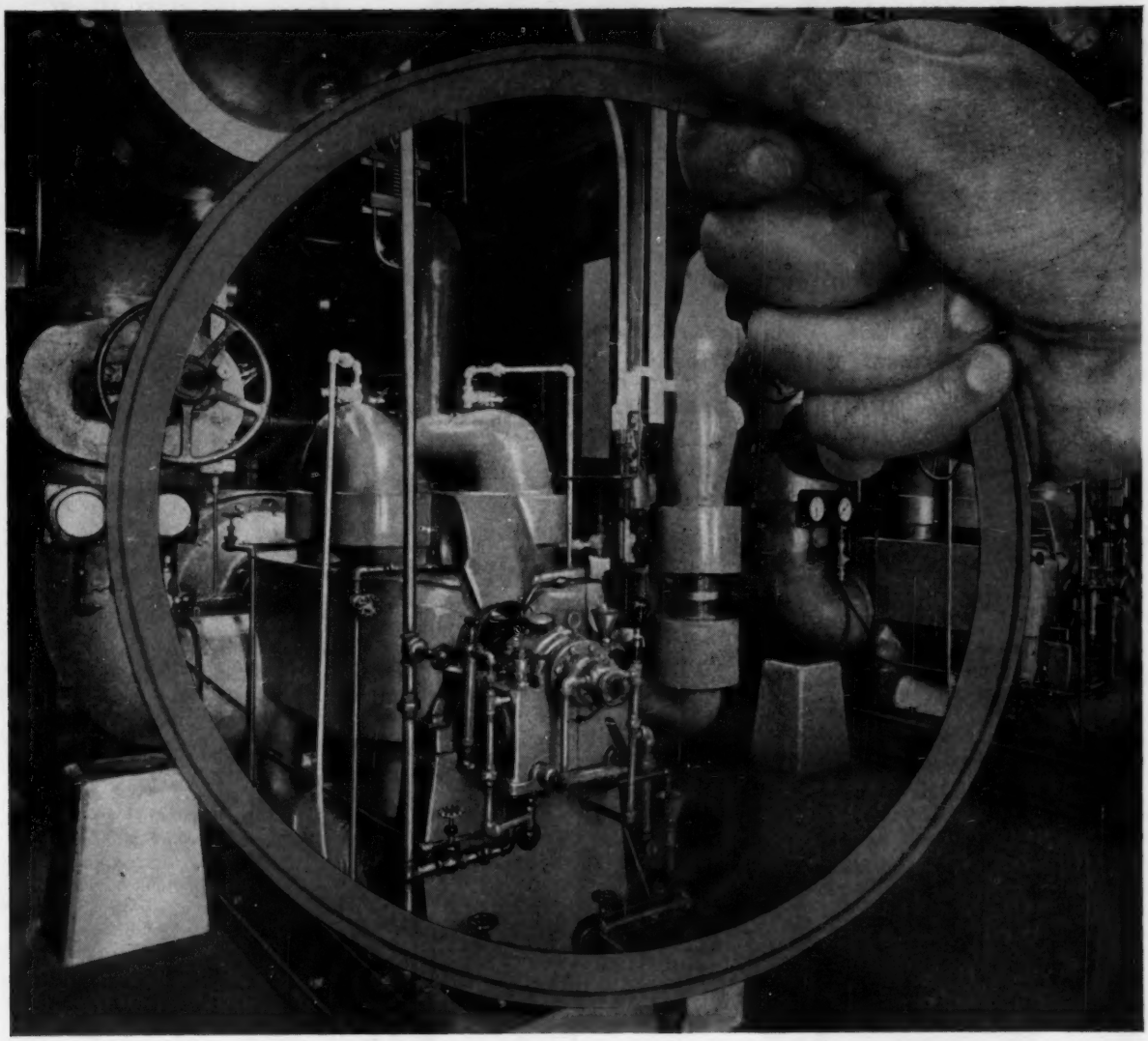
The Clark Manufacturing Co,
1830 E 38th St, Cleveland, Ohio

For more details on these items, use post cards p 163. Identify your request with item number.

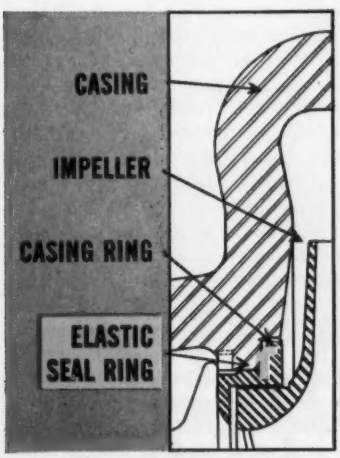
New drum upender

732 • Device is used for manually upending heavy drums with a minimum of effort. It has a 40-in. handle, offset 35 degrees for maximum efficiency in raising drums from horizontal to vertical. A 1¼-in. hook provides adequate clearance for the largest chime. The 2½ x 8-in. toe plate spreads lifting pressure over a large area to prevent drum damage.

Morse Manufacturing Company,
727 Manlius St, E Syracuse, N. Y.



This ring adds thousands of hours to feed pump life



Elastic seal ring forms a barrier between casing and casing ring. By stopping leakage, seal ring lengthens pump life.

Here's a development that permits boiler feed pumps to run thousands of hours longer before overhaul.

Since hydraulic shock can cause looseness of wearing rings and stage pieces, leakage between these parts and the casing can occur. The erosive effect of this leakage can destroy the casing in time, and cause a reduction of pump capability.

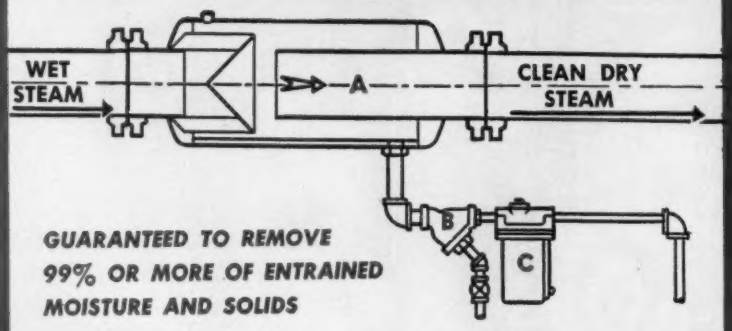
Worthington engineers have found a unique solution to this problem. A special elastic seal ring, made of tough, temperature-resisting plastic, allows for a few thousandths of an inch slippage without destroying the seating of the joint. (In fact, pressure differentials tend to seat the casing ring tighter.) This effectively stops interstage leakage and adds many thousands of hours to the pump's life.

Seal rings are standard equipment on all Worthington split-case boiler feed pumps, 100 to 2,500 gpm. Worthington Corporation, Harrison Pump Dept., Harrison, N. J. CA3

WORTHINGTON

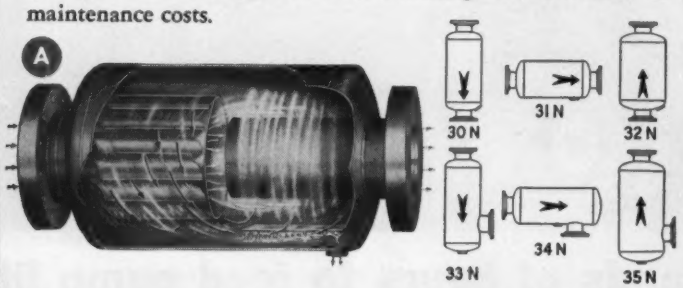
NOW—

The driest, cleanest steam available, is yours with this Wright-Austin equipment

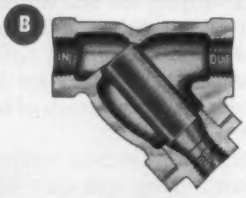


GUARANTEED TO REMOVE 99% OR MORE OF ENTRAINED MOISTURE AND SOLIDS

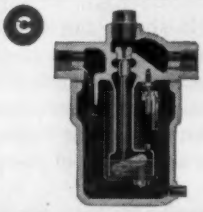
Live steam containing condensate, boiler compound, scale and other foreign matter is detrimental to equipment and is costly to super heat. These Wright-Austin accessories are engineered to give you maximum purification, resulting in lower fuel and maintenance costs.



This Wright Austin separator employs centrifugal force to remove impurities from steam, air or gas flow. The Type 31N, as well as other Models shown, are light weight, compact and sturdily constructed according to the ASME Code.



Foreign matter drains to Wright-Austin "Y" Type strainer which catches solids. These are periodically blown out by opening drain valve.



Condensate flows through strainer to Wright-Austin "Airxpel" Bucket trap. This unit automatically drains condensate as collected.

WRITE FOR NEW CIRCULAR 506-A

WRIGHT-AUSTIN COMPANY

3245 WIGHT STREET • DETROIT 7, MICH.

MARMADUKE

Continued from page 142

Oil City. One Sunday we pulled into a new refinery at Port Arthur, Texas for a cargo of gasoline. That evening while soaking up refreshments and engineering know-how at the Short Circuit Bar I ran into Fred Wasson. Fred and I had been on the Australian run years before. He told me he was the new Assistant Chief at the refinery and asked me to drop around the next morning.

"Fred's plant was new and looked like something out of a story book. Everything was spit and polish, with automatic controls everywhere. Boiler room had four new 40,000-lb-per-hr integral furnace boilers burning bunker-C oil. They steamed at 400 psi and 725 F. One 5000-kw turbine exhausted to process, another 1000-kw job was for light and emergency loads. Most of the steam went to process.

"The plant was so new some of the guarantee engineers were still around. While I was looking over Fred's new instrument panel in the engine room, a fireman came running on the double, yelling, 'We got another hot tube in No. 3 boiler, Mr Wasson, and I mean she's *hot!*'

"Fred started getting pink around the gills—then he hotfooted into the fireroom, talking to himself. I followed. After a quick inspection he and the boiler-guarantee man agreed that the tube must be blocked. With no circulation through the tube, the boiler expert said she looked like a neon light. I wasn't interested because you can't help getting an overheated tube at times even in the best-run boiler room, using the best feedwater treatment. Besides, I wasn't sticking my bow into the guarantee man's business.

"Fred ordered No. 3 boiler taken off the line after changing to bigger burner tips in the other boilers. I walked around, inspecting the rest of the plant, then returned to the fire room. By now the boys were using the emergency city-water line to cool down the boiler. The temperature dropped in a hurry without any cracking or popping. So I knew that thermal stresses were about nil.

"Then I made a tour of inspection in the refinery to learn about their latest cracking process. At noon I had lunch with the boys in the plant cafeteria. By the time I got back to the boiler room three hours had passed. The guarantee man had an operator pushing an electrician's fishtape through the suspected tube. Because the tape got through without any trouble, Fred said the tape had pushed through the mud that had clogged the tube. He and the

Twin Benefits from Mead-Morrison COAL UNLOADER

Greater Economy

because of Mead-Morrison's progressive reeving system

This system, originated by Mead-Morrison, utilizes a single continuous rope for both the hoisting and closing motions of the grab bucket. The rope is fed into the system from a storage reel in small increments to replace worn portions of the rope. By thus distributing the wear the rope is used more efficiently and a longer rope life is realized than is possible with any two-rope system.

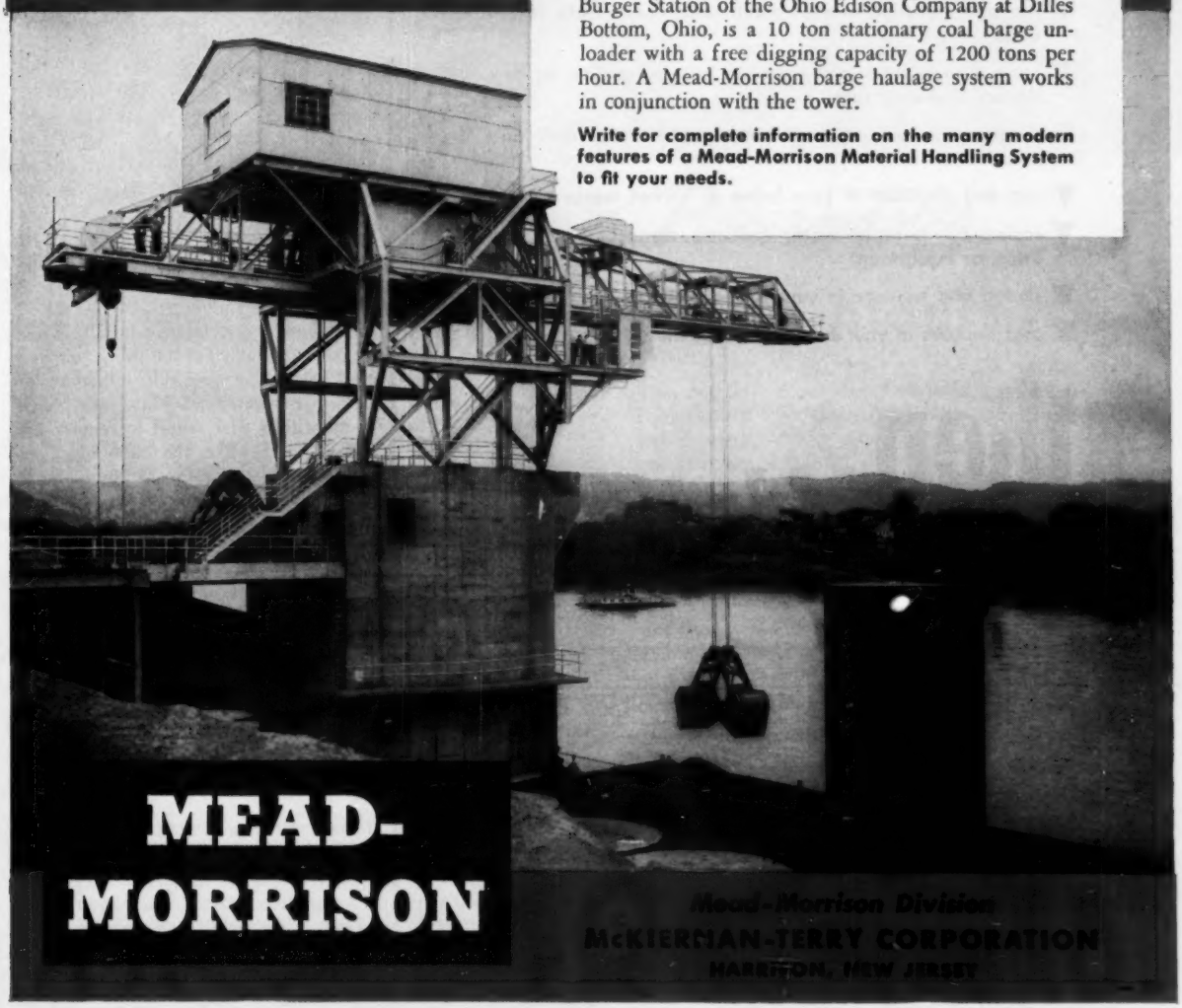
Greater Safety

because of Mead-Morrison's "dead man" control

All motions of the bucket are controlled by two short, latched levers. The operator is not forced to shift his hands from these levers at any time in the operating cycle. If the operator removes his hand from any lever for any reason, that motion is automatically stopped, thereby preventing uncontrolled motion.

This Mead-Morrison Tower installed at the R. E. Burger Station of the Ohio Edison Company at Dilles Bottom, Ohio, is a 10 ton stationary coal barge unloader with a free digging capacity of 1200 tons per hour. A Mead-Morrison barge haulage system works in conjunction with the tower.

Write for complete information on the many modern features of a Mead-Morrison Material Handling System to fit your needs.



MEAD-MORRISON

Mead-Morrison Division
McKIERNAN-TERRY CORPORATION
HARRISON, NEW JERSEY

if

you have any of these troubles:

- scale, corrosion, or foaming in your **boiler operation**
- rust and corrosion in your **steam and condensate return lines**
- scale, corrosion, or algae growth in your **cooling or condenser water system**
- corrosion or scale in your **hot or cold water tank and lines**
- rust and corrosion in your **brine or sweet water system**
- scaled up **pumps, water jackets, compressors, coils, lines, or equipment**
- sludge and moisture in your **fuel oil supply**
- soot deposits in your **furnace combustion areas**

then...

let WESTERN prove to you how a specific treatment applied to your specific problem can restore and maintain efficiency and economy in your use of water, steam, and fuel. Mail the coupon today for full information.

65 Years Experience in the Chemical Treatment of Water.

Chemical Treatment for Water Steam and Fuel

WESTERN CHEMICAL COMPANY

713 Washington Street
Kansas City 5, Missouri

MAIL THIS COUPON TODAY

Please send information about.

_____

_____

_____

Name _____

Firm _____

Address _____

City _____ Zone _____ State _____

MARMADUKE

Continued from page 182

guarantee man were happy about it. But Fred said this was the third time it had happened to that same tube in the past few days.

"While the work was going on I looked inside the steam and mud drums for signs of scale. There wasn't any, so I guessed they were treating their feedwater OK. Fact is, I didn't even see signs of scale in the tube they claimed had been hot. That got me to thinking.

"With the boiler closed and then filled up, the oil burners were put back on. Just about the time I started leaving the plant for my ship, the fireman came running out to Fred's office again, yelling that the same tube was hot.

"Fred started popping his safeties. He excused himself and made tracks for the boiler room. But I stuck hot on his trail. This time I looked into the rear peephole myself. Sure enough, there was what appeared to be a red-hot tube. I took another look, blinked my eyes a few times, then asked Fred to have his fireman turn off the top oil burner. After a minute I looked again.

" 'That's enough for me, Fred,' I said, slapping him on the back. 'You don't have any hot tube in there. What you saw was the reflection from your front wall.'

" 'What?' piped up the young guarantee engineer, staring at me as if I had a loose gusset stay.

" 'Hey?' questioned Fred, giving me a dubious look. 'Then how come the rest of the tubes in that general area aren't just as red?'

" 'That's easy,' I answered. 'When your boiler gang put the refractory into that boiler, they probably spilled boiler cement on that tube. Then they buffed it up with a wire wheel to remove the cement and make the tube clean as before. And that's the hot tube you've been seeing every time that top burner was on.'

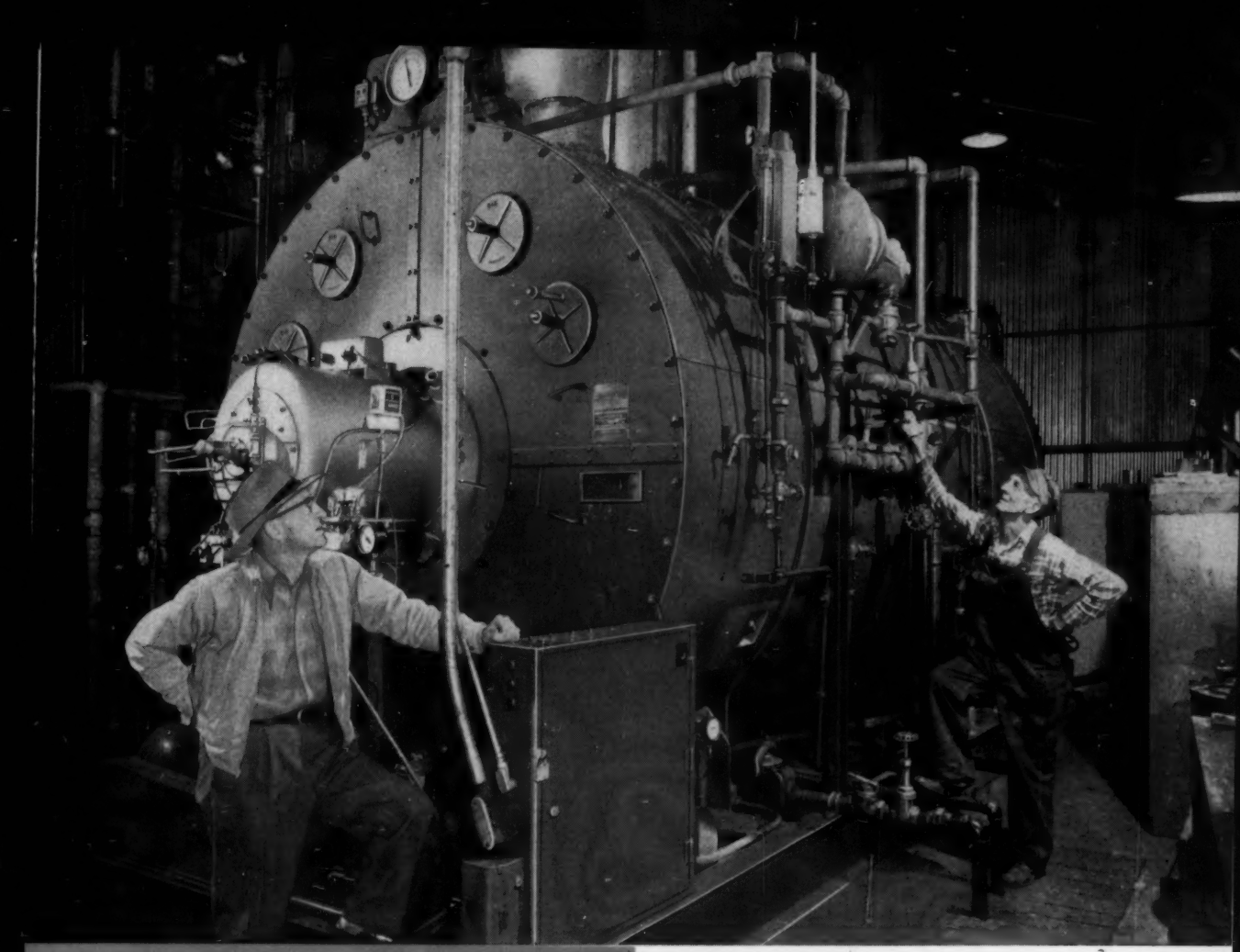
" 'How the heck do you figure that?' asked Fred, scratching his head and giving me a fishy look.

" 'Simple,' I answered. 'When I turned off the top burner, the tube didn't glow. That red tube could only have been light reflection. Then again, I noticed that your *hot tube* had some piping marks on it that showed up black. You just can't see black marks on a red tube.' "—*SME*

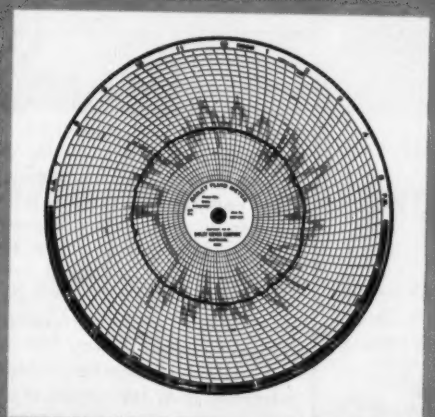
JITTERY TURBINE IS FINE

Marmy's sure-fire cure for turbine jitters is splendid, excellent, very good for digestive system. Many years ago, I had a similar experience and enjoy looking back on a job well done.

C BACHMANN *Rego Park, N. Y.*



Why does ONE *Powermaster*® sell OTHERS in nearby plants?



This 24-hr. pressure and flow chart shows the ability of the *Powermaster* to hold constant pressure under widely varying steam flow conditions. The basic simplicity and rugged construction of the *Powermaster* modulating burner control promptly adjusts fuel firing rate to steam demand, thus, automatically holding boiler pressure constant throughout the entire steam demand range of the boiler.

This 500 HP *Powermaster* Packaged Automatic Boiler installed in a West Coast food processing plant has led to the purchase of four *Powermaster* units by other companies in the same area.

The reason for these extra sales is because *Powermaster* is solving two steam problems—more steam for processing, and more efficient off-season heating by means of modulating control of firing rate.

You can now purchase a completely factory-assembled and fire-tested *Powermaster* on the new Pay-As-You-SAVE Purchase Plan that helps you pay for your new boiler out of the savings it brings you.

Write for Bulletin 1220 or ask our representative to tell you how *Powermaster* can meet your requirements.

Powermaster®

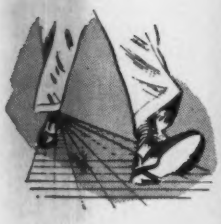
PACKAGED AUTOMATIC BOILERS

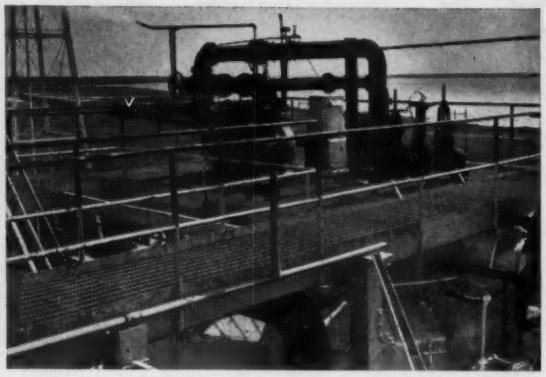
Builders of Dependable Boilers Since 1885

ORR & SEMBOWER, INC.

Morgantown Road, Reading, Pa.

WHERE SURE FOOTEDNESS COUNTS

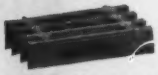




Gary

STEEL GRATING MAKES WALKS SAFER

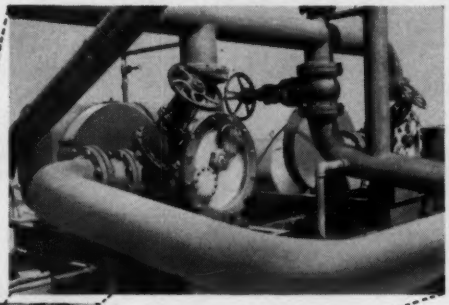
Sturdy, one-piece construction with tops of all bars flush provides open steel flooring and stairs for safe, easier walking. Gary Grating is furnished in a wide variety of neat appearing designs and sizes—and is tailor-made to fit your needs. For complete description and installation pictures on Gary Welded Grating, Stair Treads and Gary-Irving Decking, ask for Catalog P-76.



FREE SAMPLE
We'll send this handy paper weight if you request it on your company stationery.

Standard Steel Spring Division
ROCKWELL SPRING AND AXLE CO.
4018 East Seventh Avenue • Gary, Indiana

MILLION-GALLON WEEK-ENDS...



...are just part of the pumping job at this terminal

Lake River Terminals, Inc., Argo, Illinois, is a 42,000,000 gallon barge terminal for petroleum and other products. A typical week-end for them includes unloading and complete stripping of four barges in 43 hours by two Viking Pumps. Total capacity is 1,000,000 gallons. Besides those, the Terminal has two Viking 6-inch pumps and a battery of five 2-inch Vikings. You see, Vikings are kept busy helping in the successful operation of the terminal. Vikings like tough pumping jobs like this. If you have a pumping problem, write for bulletin. 56Sw.

VIKING PUMP COMPANY
Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" pumps
THE ORIGINAL "GEAR-WITHIN-A-GEAR" ROTARY PUMP

My biggest boner

Before going into steam engineering I worked on a small experimental still in an oil refinery. One job on that 45-gallon still required turning steam directly into the oil-filled still. I was instructed to hold the pressure at 12 psi.

When I opened the steam valve there was no steam. Then, leaving the valve open, I began tracing the line back to find where it was shut off. At last I came to the main line and found a 3-in. valve shut. I opened it and returned to the still.

Here I found the pressure gage still reading zero. This seemed peculiar because the little still was almost jumping off its foundation from the violent boiling inside. Checking closer, I noticed the gage's needle was actually on the pin's *other* side.

Throttling down on the valve brought the needle back to the required 12 psi. I later learned that this still had been tested for 25 psi while I evidently had full-line pressure of 125 psi.

This near-fatal boner taught me a lesson: Never open pressure valves without checking and rechecking to make doubly sure that you know exactly what you are doing.

J H Burns *Sarnia, Ontario*

FLUIDIZED FIRING

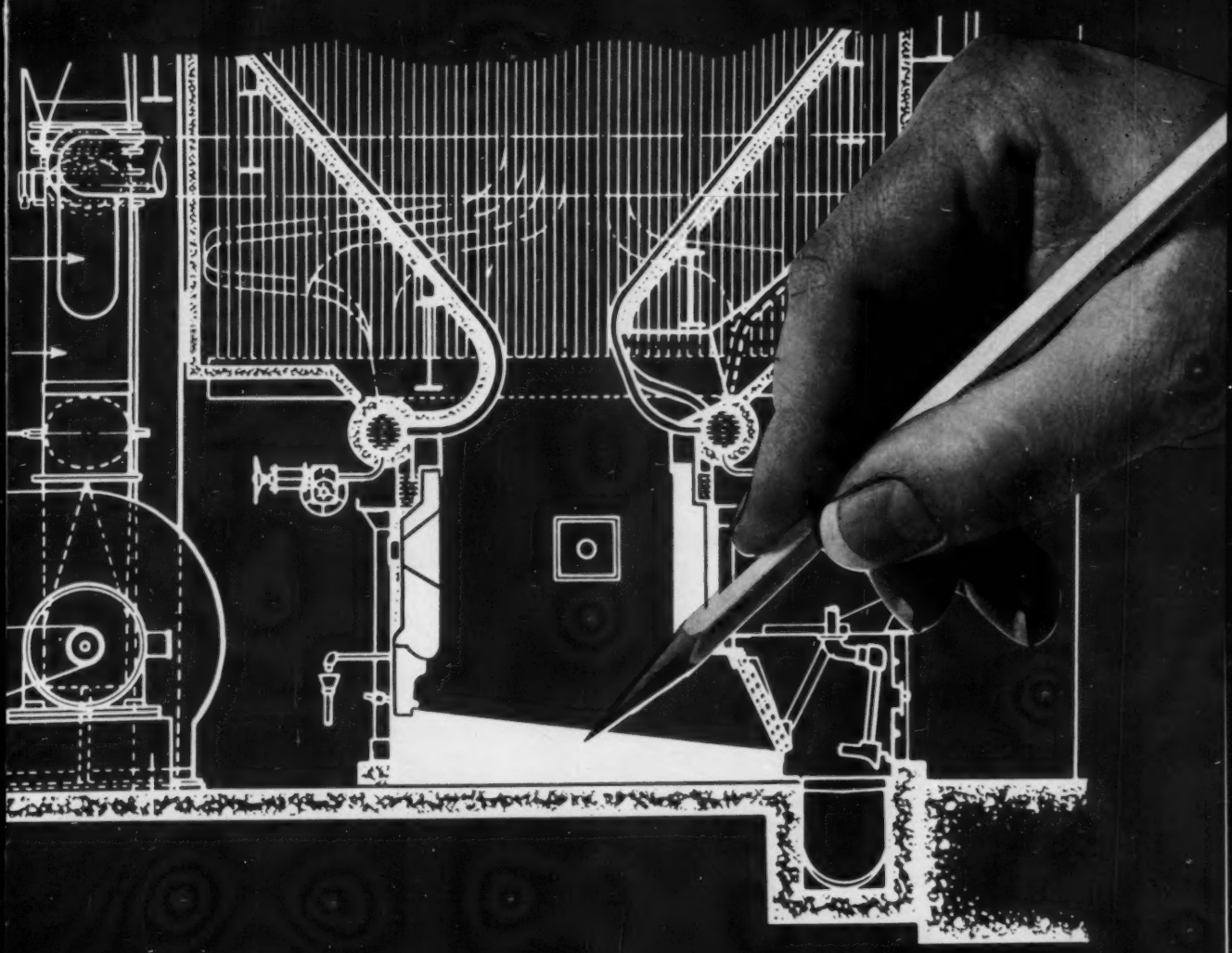
Continued from page 88

Experimental work continues with burning of all coal types having a wide range of characteristics. Tests cover particle size, moisture content, ash content, ash fusibility, volatile matter content and caking tendencies. So far, none has caused any specific difficulty.

Tests prove that fluidization can be used under boilers rated as low as 6000 lb per hr. Maximum capacity is a matter of conjecture. The technique appears to have unlimited range. On the basis of data in hand, calculations show that it would be feasible for an 800,000-lb-per-hr boiler.

Fluidized combustion technique has advanced from experiment to reality in a permanent productive capacity. Fig. 1 shows the modern boiler designed and installed by the Societe Francaise des Constructions Babcock et Wilcox for the City of Macon, France. A single-pass radiant-type boiler, it has a capacity of about 40,000 lb per hr. Operation has just begun.

How to draw the line on ashpit maintenance



"Let's put Kaocrete here"

Relining ashpits is expensive and time-consuming. That's why more and more utilities and industrial companies are specifying a heavy-duty refractory castable such as B&W Kaocrete D. On job after job, it has withstood the heavy abrasive or erosive attack of sprays, jets, rakes or shovels.

The reason? Specially designed Kaocrete D has the strength and hardness needed for tough ashpit service. It has unusually high resistance to abrasion, erosion and spalling. It saves time because it can be poured or gunned into place. For less severe abrasive or erosive conditions, B&W recommends Kaocrete A.

Get the facts and figures on these B&W Refractory Castables from your local B&W Refractories Engineer.

Send for Bulletin R-36 which gives data on B&W's wide line of specialized boiler refractories.

BABCOCK & WILCOX

THE BABCOCK & WILCOX CO.
REFRACTORIES DIVISION
GENERAL OFFICES: 161 EAST 42nd ST., NEW YORK 17, N.Y.
WORKS: AUGUSTA, GA.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

R-36

"If it weren't for our Pritchard Hydryer, that air line would be frozen-up!"

"How do you mean that, Herb?"

"Let me put it this way. We use a lot of compressed air to operate our instruments and control air system here in the plant."

"So far, I follow you, but what does the Hydryer have to do with it?"

"It's a lot like your car, Sid. You know what happens when you get water and moisture in your gas line. Trouble! The Pritchard Hydryer removes all the moisture from the air stream and keeps the lines from freezing up. That way we can run our air lines outside the main plant. By using only dry air, we have far less maintenance costs on our air cylinders and valves. Even in warm weather we have to keep that air dry."

"Just one more question, Herb."

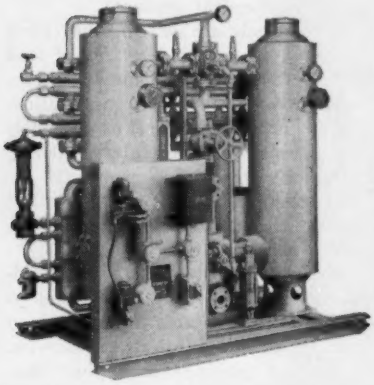
"What's that?"

"Do we have to stand outside here and freeze?"

J. F. PRITCHARD & CO. OF CALIFORNIA
4625 Roanoke Parkway, Kansas City 12, Mo.

"If it weren't for our Pritchard Hydryer, that air line would be frozen-up!"

FOR EFFICIENT LOW-COST DRYING OF INSTRUMENT AND CONTROL AIR . . . CHOOSE A PRITCHARD HYDRYER®



Many exclusive features of the Pritchard HYDRYER make it ideal for low-cost drying of instrument air as well as compressed air for air control systems. Features such as:

- NO WASTE—100% of all air entering the HYDRYER is dried without loss
- FULL LINE PRESSURE REACTIVATION—Pressuring and depressuring of adsorbers between cycles is eliminated
- NO PURGING—The Type A HYDRYER uses inlet main air streaming for reactivation
- LONGER ADSORBENT LIFE
- NO MOVING PARTS
- SIMPLIFIED OPERATION
- REDUCED EQUIPMENT AND LINE SIZES

. . . and many other proved advantages.

WRITE TODAY FOR BULLETIN

Get the whole story on the Pritchard HYDRYER. Write for your complimentary copy of Pritchard Bulletin 16.0.081, *today* on your company letterhead.

INDUSTRY'S PARTNER FOR PROGRESS

J. F. Pritchard & Co.
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept. 520, 4625 Roanoke Parkway
Kansas City 12, Missouri

COOLING TOWERS • GAS & AIR TREATING EQUIPMENT
REPRESENTATIVES IN PRINCIPAL CITIES FROM COAST TO COAST

WATER TREATMENT

Continued from page 85

test. The latter is considered slightly more accurate.

It is usually impossible to have hardness and phosphates in the boiler at the same time. But with sodium carbonate softening, hardness of 10 ppm may be observed along with an excess of carbonate and hydroxide. So hardness tests check whether chemical reaction in the boiler is complete and show whether the water has a reserve of softening chemicals.

Silica content is particularly important at pressures above 600 psig. It is believed to carry over by vaporization at the higher temperatures associated with higher pressures. If you limit silica to 5 ppm or less, the amount carried over by vaporization or physical entrainment of water droplets does not usually cause troublesome deposits on turbine blades.

Silica deposits on boiler surfaces are dense and hard to remove. Carefully controlled boiler-water treatment prevents them.

Desirable analysis. For the usual central-station boiler with tight surface condensers and low percentage makeup from evaporators or deionizing equipment, desirable analysis runs about as follows (for elements usually tested):

Phosphate as PO_4	30-40 ppm
Hardness as $CaCo_3$	0 ppm
Sulfite as Na_2SO_3	10-20 ppm
Sulfate as Na_2SO_4	100-200 ppm
Chlorides as NaCl	0-100 ppm
Silica	0.5 ppm
pH	10.5-11.0 ppm
Methyl orange alkalinity	50-100 ppm

Phosphate concentration may be raised by adding monosodium, disodium or trisodium phosphate as needed to control pH and methyl orange alkalinity. If phosphate content is normal there should be no hardness. If you find any, recheck the analysis technique.

Adding sodium sulfite raises sulfite concentration. Entrance of dissolved oxygen with the feedwater, or breakdown of the sulfite decreases its concentration. Oxidation increases the quantity of sodium sulfate. Oxygen may also be released in the boiler through water breakdown. Should you note no increase in sulfate concentration to match decrease in sulfite content, the sulfite may be breaking down and vaporizing into the steam as hydrogen sulfide.

Sodium sulfite's use rate seems to be related to its concentration. A level of 10 ppm appears adequate to protect against oxygen corrosion. So if

Catawissa
PERFECT SEAL
Unions

HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

Standard & Double Extra Heavy
UNIONS
Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

ORIFICE UNIONS
With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

MALE & FEMALE UNIONS
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

FULL STAINLESS & FULL ALLOY STEEL UNIONS
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.

WRITE FOR CATALOG 56
showing the complete Catawissa line of Perfect Seal products

CATAWISSA VALVE & FITTINGS COMPANY
206 MILL ST. • CATAWISSA, PA.

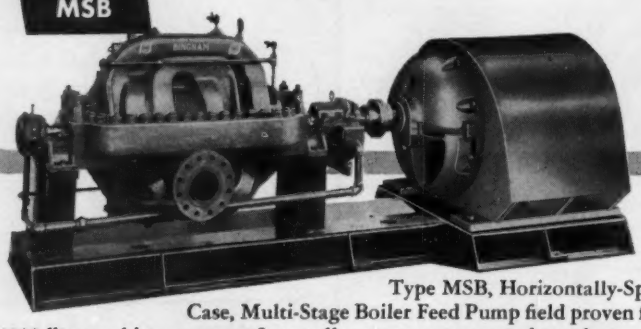
Specify

Bingham

"DOUBLE VOLUTE"
BOILER FEED PUMPS

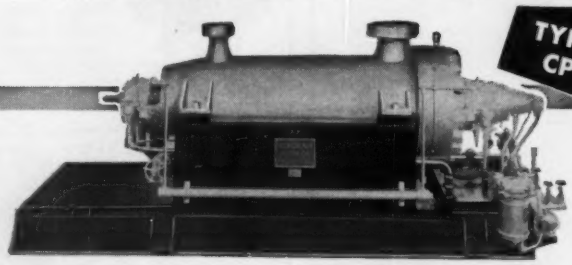
for the ultimate in dependability
IN HIGH PRESSURE SERVICE

TYPE MSB



Type MSB, Horizontally-Split Case, Multi-Stage Boiler Feed Pump field proven for 1200 lbs. working pressure. Integrally cast cross-overs and evenly spaced case bolting located uniformly close to the shaft center line, enclosing a minimum pressure area, eliminate case distortion and inter-stage jetting.

TYPE CP



Type CP, Multi-Stage, Double-Case Boiler Feed Pump with forged outer barrel for high pressure service.

All BINGHAM Boiler Feed Pumps feature: (1) "Double Volute" construction, resulting in full radial balance of the rotating element *throughout the entire operating range of the pump.* (2) Double suction first stage for low NPSH. (3) Balanced axial thrust (no balancing drums needed). (4) Kingsbury Thrust Bearings. (5) Stuffingboxes subjected to suction pressure only. (6) Design for High Speeds.

Bingham
SINCE 1921

DOUBLE VOLUTE PUMPS RADIAL BALANCE

BINGHAM PUMP COMPANY
General Offices: 2800 N. W. Front Ave., Portland 10, Oregon
Factories: Portland, Ore. • Vancouver, B. C., Canada

SALES AND SERVICE OFFICES

Boston, Mass.	New York City, N. Y.
Chicago, Ill.	Philadelphia, Pa.
Cleveland, Ohio	Pittsburgh, Pa.
Dallas, Texas	San Francisco, Calif.
Denver, Colo.	Seattle, Wash.
Houston, Texas	St. Louis, Mo.
Kansas City, Mo.	St. Paul, Minn.
Los Angeles, Calif.	Tulsa, Okla.
New Orleans, La.	Toronto, Ont., Can.
Vancouver, B. C., Canada	

WATER TREATMENT

Continued from page 189

sulfite loss is excessive at higher levels you may have to sacrifice the reserve protection of a higher level to avoid excessive use.

Quantity of chemicals for internal treatment can be estimated if you know the weight of water normally in the boiler. Calculate this from internal volume of the components, or obtain it from the manufacturer. Dividing weight of water into one million gives approximate increase (ppm) that one pound of chemical produces.

If chemicals are fed in slugs by a feeder on suction or discharge of feed pumps, you quickly obtain desired increase in boiler chemical concentration. But adding large amounts of chemicals this way may cause temporary priming.

With a chemical feed pump, the desired chemicals may be mixed up in a feeder tank of water, then pumped in over a period of time.

Water to dissolve treatment chemicals should be as pure as possible—preferably condensate. Mix enough to dissolve all the chemicals. Otherwise, undissolved particles may plug lines and valves or cause pump trouble. If phosphate is dissolved in water containing calcium or magnesium, sludge from the precipitated hardness may plug the lines.

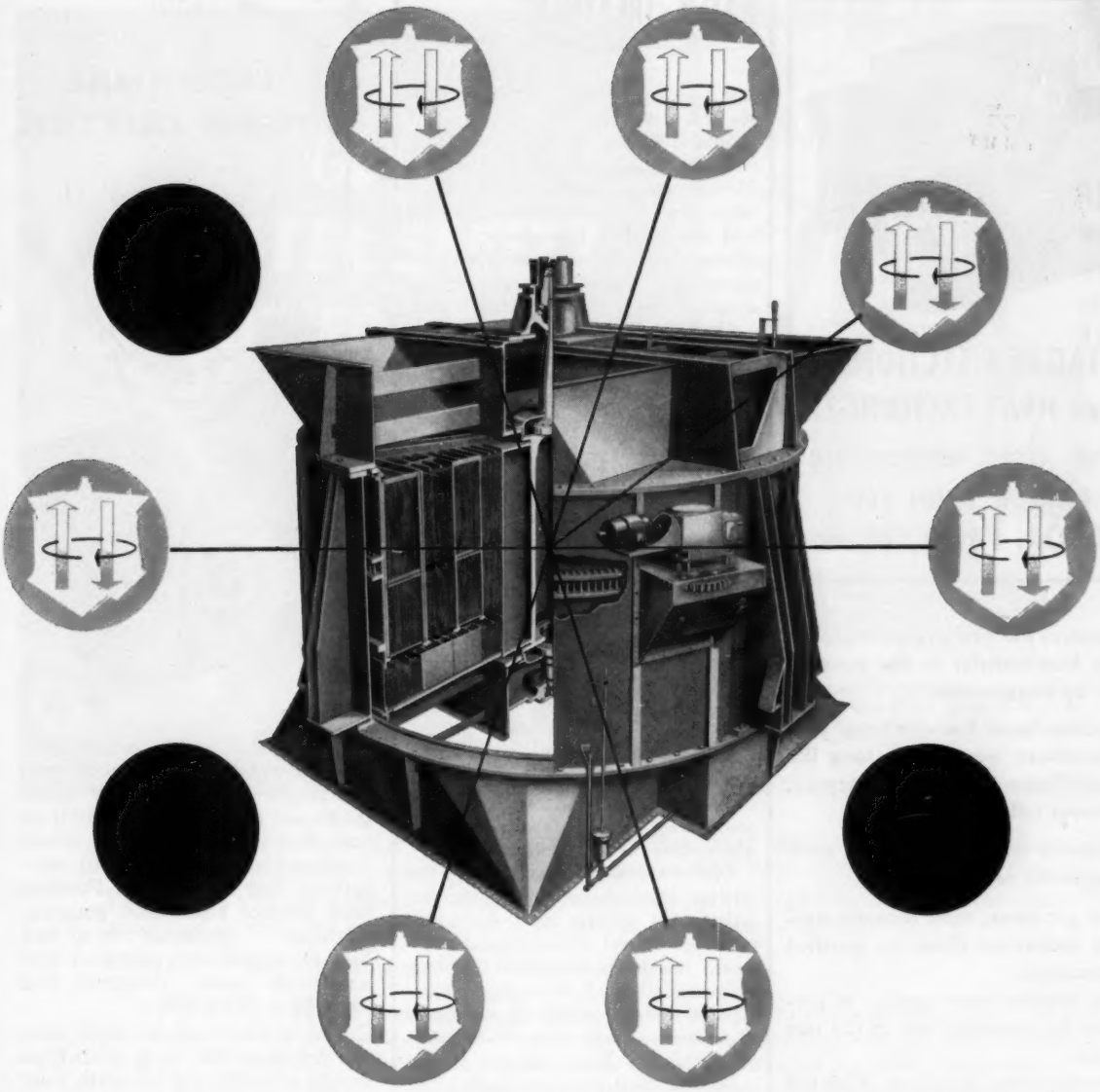
Boiler blowdown is the usual way to lower concentration of silica, chlorides or other dissolved solids. Of course, all elements are decreased equally, and chemicals have to be added to hold phosphates, sulfites and alkalinity at desired value. Where possible, control amount of impurities entering the boiler rather than try to get rid of them by blowdown.

Where chemicals are added to feedwater rather than pumped direct into boilers, undue concentration may occur in one boiler, with corresponding shortage in another. This results from (1) uneven distribution in feedwater or (2) carrying a higher load on one boiler while continuing blowdown at the same rate for all. Correct this by varying blowdown rate on individual boilers or feeding a "slug" of chemicals while low-concentration boilers operate at higher rating.

Phosphate lines are often run direct to individual boiler drums to avoid possibility of deposits in feed pump, feedwater lines or control valves. You get the same effect with pressure feed tanks above boiler-drum level.

Sulfite is best fed on the suction side of the feed pump. This provides some protection against oxygen corrosion in feed lines and economizers.

(*Continued on page* 192)



7 out of 10 air preheater installations are Ljungstrom®

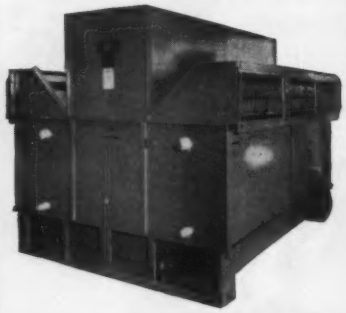
Advantages of the Ljungstrom Air Preheater

- Size for size, recovers more heat than any other type.
- Reduces fuel consumption. Permits use of lower-grade fuels. Increases boiler output and reliability.
- Eliminates cold spots . . . keeps corrosion to a minimum.
- Easier, faster to clean and maintain.
- Requires far less supporting steel and is quickly erected.

FUEL ECONOMY is the big reason. Size for size, the Ljungstrom recovers more heat than any other type of air preheater. And with every 45-50 F of air preheat you cut your fuel bill 1%.

Write now for your copy of our 38-page manual, for handy reference.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.



NIAGARA SECTIONAL *Aero* HEAT EXCHANGER gives close temperature control, saves you LABOR, Power, Water

- **Because the new design improves the heat transfer to the out-door air by evaporation.**
- **Because new features keep your equipment working for long life with "new plant" efficiency . . . always full capacity.**
- **Because you save 95% of cooling water cost.**

You get faster, more accurate cooling of industrial fluids to specified temperatures.

You improve your quality of production by removing heat at the rate of input.

You save labor in upkeep. With full access to all interior parts and piping you see everything in easy inspections. You head off dirt accumulation and corrosion. Casing panels are removable without moving the coils. The coils can be cleaned from both sides.

First cost is low; freight is low because of the lowest space/weight ratio; you save much labor in erection. Capacity range is 7,000,000 to 18,000,000 Btu/hr. No other heat exchange method gives you so much saving in money and convenience.

Write for Niagara Bulletin No. 132

NIAGARA BLOWER COMPANY
Dept. P, 405 Lexington Ave.
NEW YORK 17, N. Y.
District Engineers in Principal Cities of U. S. and Canada

WATER TREATMENT

Continued from page 190

You need continuous feed for continuous protection.

Automatic systems can be set up to feed chemicals at varying rates and intermittently, if desired. Calculate solution strength to correspond to the feed rate. Safety precautions for the solution tanks should include low-level alarms and screens to catch any undissolved chemicals or foreign matter.

Chemical feed pumps are usually reciprocating plunger type with a double spring-loaded ball-type valve on suction and discharge. These valves are readily dismantled to clean and inspect.

Install check and shutoff valves near each boiler or other point of pressure connection. Put a relief valve on the pump discharge. Then pump will not be damaged if discharge valves on lines to all boilers are shut.

Lines from solution tanks to pump suctions are usually arranged with fittings so they can be "rodded" out. Provide at least two pumps for phosphate feed; one acts as a spare and supplies extra capacity when needed.

A pure-water connection to the solution tank permits flushing out tanks, pump and lines to boilers after feeding phosphate. This is especially useful where chemical is fed intermittently.

Central-station boilers with very low makeup quantities and pure water for makeup are perhaps most susceptible to proper control of boiler-water treatment. But heavy evaporator priming, malfunctioning of deionizing equipment or surface-condenser leakage may allow sudden large increases in solids concentration. These call for prompt correction. Best practice: Check boiler water daily, provide for continuous recording of the purity of condensate, system makeup and steam.

As makeup needs increase, difficulties of treatment and control also increase. Where makeup is above 5%, evaporator size usually becomes excessive. Some other treatment—like zeolite lite or lime-soda softening—is needed.

Impurities in makeup usually force an increase in total solids concentration in the boiler. Otherwise, the large amount of blowdown required would considerably raise heat losses and still further increase makeup needs.

Steam pressures are usually selected in inverse ratio to probable solids concentration in the boiler. This avoids troubles. Total solids concentration of 4000 to 6000 ppm is permissible if boiler is liberally designed so there is ample space for steam-water separation and no "hot spots." Careful control of makeup water pretreatment sys-

NEW

INTERNAL TUBE CUTTER

cuts faster more economically

AIRETOOL'S new, lightweight, portable tube cutter removes heat exchanger and condenser tubes faster and more economically than ever. Self-centering, double-action hardened steel tool bits cut nonferrous and steel tubes. Positive feed control eliminates gouging, burning . . . increases life of tool bits. Equipped with powerful *new* air-driven motor, designed and built by AIRETOOL.

Cutter is also available with electric driven motor, or in push-type design adaptible for use with your own electric or air motors.

Send for Bulletin #59, illustrating the complete, new line of AIRETOOL Tube Cutters, cleaners, expanders, accessory and specialty tools.

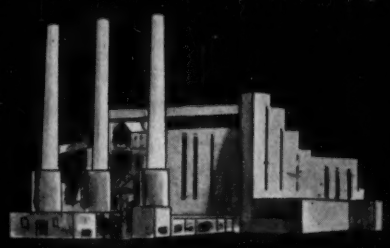
AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

BRANCH OFFICES: New York, Chicago, Tulsa, Philadelphia, Houston, Baton Rouge.
REPRESENTATIVES in principal cities of U.S.A., Canada, Mexico, South America, England, Europe, Puerto Rico, Italy, Japan, Hawaii.
EUROPEAN PLANT: Vlaardingen, The Netherlands

GET GREATER SAFETY AT LOWER COST...

CHOOSE THE TYPE 1511

CONSOLIDATED SAFETY VALVE



TYPE 1511 CAST IRON BODY SAFETY VALVE
SIZES: 1½" through 6". **PRESSURES:** up to 250 psi. **TEMPERATURES:** up to 450° F. All sizes except 6" available with oversize flanges.

Maximum safety comes first in power engineering. But lower initial equipment investment and lower maintenance costs are also essential factors. The Type 1511 Consolidated Safety Valve gives you all three. It is an all-purpose safety valve, expressly designed for steam generator service, yet costs less than other makes for the same service.

Among the many advantages of the Type 1511 are:

1	Positive tightness because the seat is precision lapped to optical flatness.
2	Stable operation and uniform blowdown control because the spring is exposed.
3	Better alignment, easier blowdown adjustment and finer performance because the valve has an integral, double-guided combination adjusting ring and disc guide.
4	Cuts the cost per pound of steam discharged because maximum capacity is designed into minimum flange size. The size and/or number of safety valve nozzles required on any boiler are reduced.
5	Saves space – requires less headroom and smaller discharge piping.

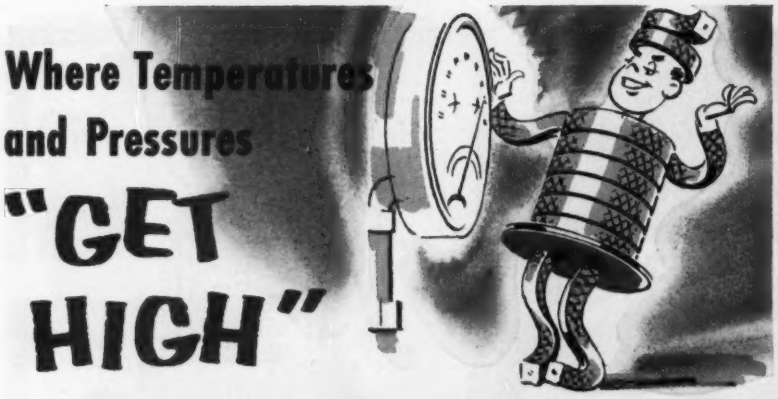
The Type 1511 Consolidated Safety Valve is made in a full range of sizes and orifices. Write for Bulletin 730 and learn the complete story of the greater safety and economy of the Type 1511.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario.*

CONSOLIDATED SAFETY VALVES

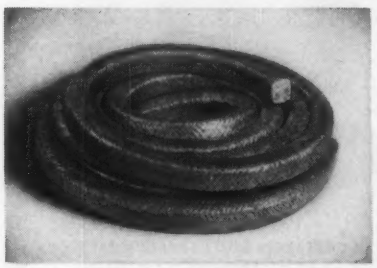
A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, CONSOLIDATED SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*



Where Temperatures and Pressures "GET HIGH"

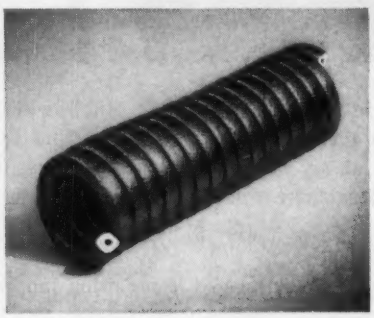
...you need these packings!



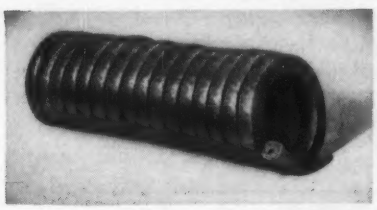
Style HP-2M – excels against severe temperatures and pressures. A braided asbestos packing reinforced with a monel wire insertion. For use on centrifugal and reciprocating pumps, valve stems, expansion joints, etc.

Style No. 30 – a very dense braided asbestos packing, highly resistant to high pressures. For use against petroleum products at high temperatures and pressures.

Style HP-RC – a wrapped asbestos cloth packing with a resilient rubber core. For use on steam hammers, expansion joints, pumps and piston rods calling for high pressure steam, air and gases at temperatures to 600 degrees F.



Style HP-RB–for high pressure steam service up to 600 degrees F. Constructed with a core of accordion-folded asbestos cloth and a resilient rubber back, around which is wrapped a closely woven asbestos cloth jacket.



Aquapak Hydraulic Packing – a semi-metallic packing designed to withstand severe hydraulic pressures. Will give satisfactory service on pressures as high as 10,000 pounds. For use against hot and cold water on centrifugal and reciprocating pumps, outside packed boiler feed pumps and similar equipment.

ALLPAX

"The Packing that Packs All"

SEND FOR OUR NEW CATALOG — TODAY!

A complete line of packing, tools, gasket materials
Distributors in principal cities

THE ALLPAX COMPANY, INC.
160 Jefferson Ave., Mamaroneck, N. Y.
CANADIAN DISTRIBUTORS: Albion Asbestos Packings Ltd., Montreal 8, Quebec

WATER TREATMENT

Continued from page 192

tem prevents entry of hardness or other hard-to-handle impurities.

With the possible exception of small industrial boilers, shut down nightly and over weekends, and drained, get recommendations from a qualified water-treatment consultant or, at least, a reputable water-treatment firm.

If the makeup water has no bad characteristics, the nightly blow-down to keep boiler from popping after shutdown, plus a complete refill each weekend, sometimes keeps scale from building up. But this fortunate situation is the exception, not the rule. Watch boiler surfaces closely for corrosion or deposit. Some form of internal water treatment is usually desirable.

Keep blowdown valves tightly closed when not in use. Get manufacturer's recommendation on which valve to use for throttling and which for shutdown.

Continuous blowdown valves should be the "plug" or "needle" type, of durable material to stand continuous erosion of hot water. Mark positions or openings on the valve, so any amount of blowdown can be duplicated if valve is opened or closed.

One person, usually the man responsible for feedwater treatment, should issue all blowdown instructions. He should write these orders, so all shifts know what is going on. The alternate is for the water-treatment man to regulate continuous blowdown valves himself. This can lead to confusion. Similarly, add internal-treatment chemicals at times and in amounts specified in writing by the responsible water-treatment man; the less desirable alternate is for him to make the additions himself.

PIPING

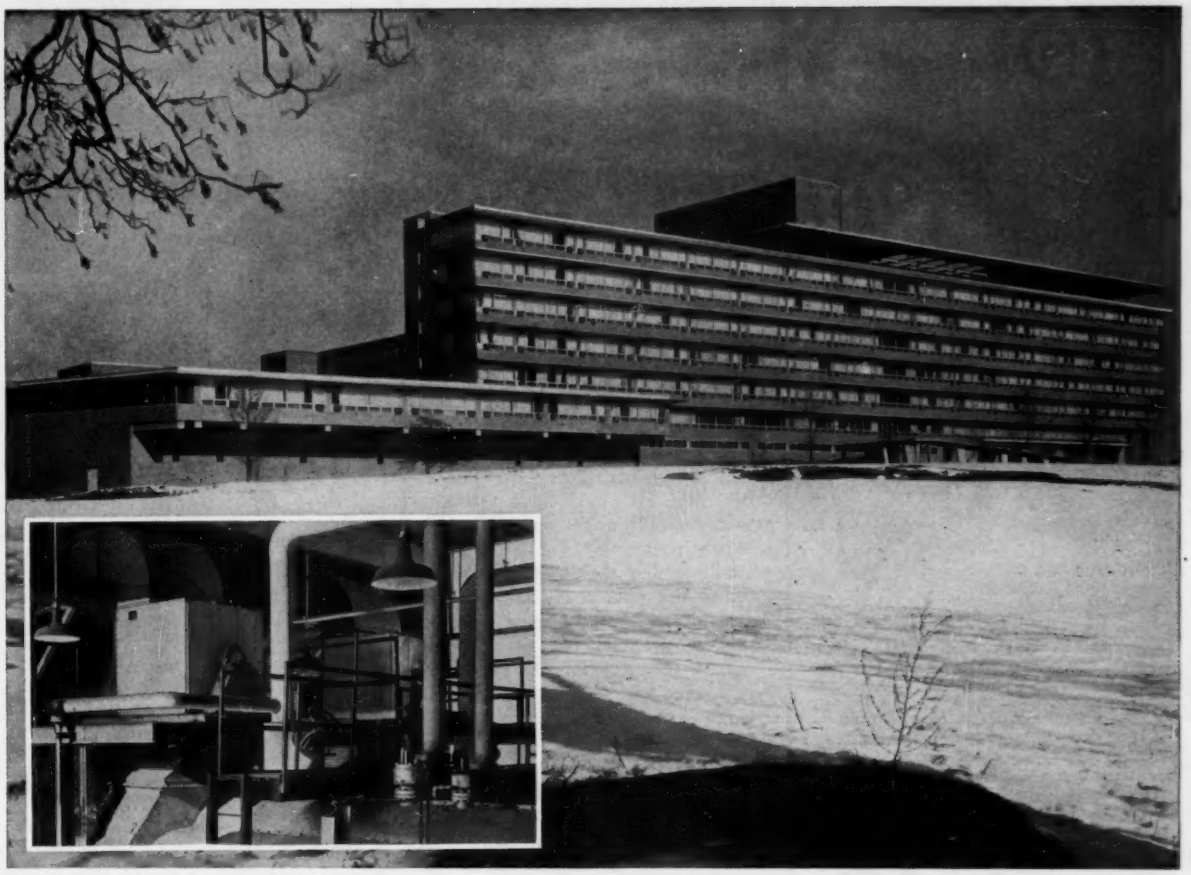
Continued from page 102

the weld is completed by any suitable welding method, Fig. 4. The possibility of applying this technique to steam-power piping occurred as a result of work on special fabrication of monel, nickel and stainless thin-wall piping for a chemical-plant installation where the internal surface had to be smooth in contour, free of crevices, notches, cracks, voids or any obstructions.

Because of excellent results with the inert-arc process for this fabrication, efforts were turned toward applying this procedure to steam-power-plant piping. However, the transition from light-wall tubing to heavy-wall alloy-steel pipe required many welding tests for full evaluation of a suitable welding procedure.* Welding tests were per-

*"Inert-Arc Welding Technique for Eliminating Backing Rings in Piping," R A Mueller & W B Root, "Welding Journal," March 1953.

Vincent G. Kling, Architect | A. Ernest D'Ambly, Mechanical Engineer | W. M. Anderson Company, Mechanical Contractors

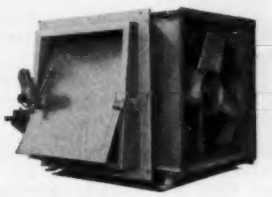


The Last Word in Modern Hospital Design Naturally Uses the Last Word in Mechanical Draft

THE LANKENAU HOSPITAL, in the suburbs of Philadelphia, is one of the world's most modern hospitals, both in architecture and equipment. The hospital itself was established in Philadelphia in the mid-nineteenth century, and has a distinguished history. It moved to its new building in 1953. In specifying equipment, its designers selected the most modern, the most efficient, the most scientific that could be found.

When it came to draft inducers for the boiler plant, they naturally selected Wing, which fulfill all those requirements, and in addition have back of them a lineage almost as old as Lankenau's own.

Wing Draft Inducers cut capital cost through elimination of high stacks, reduce maintenance costs, and result in sizeable fuel savings. They provide positive, adequate, uniform draft for boilers or furnaces entirely independent of weather conditions. And they save money through higher fuel-burning efficiencies. You should learn more about them. Write for Bulletin I-56.



Wing

DRAFT INDUCERS

L. J. Wing Mfg. Co. 50 Vreeland Mills Rd., Linden, N.J.
Factories: Linden, N.J. and Montreal, Canada

WING REVOLVING HEATERS

WING FRESH AIR SUPPLY HEATERS

WING BLOWERS

WING TURBINES

Mail the coupon for bulletin

L. J. Wing Mfg. Co. P-7
50 Vreeland Mills Rd., Linden, N. J.
Please send copy of Draft Inducer Bulletin I-56.
Name .....
Firm .....
Address .....
City ..... Zone ..... State .....

Choose A Standard SCAM ALARM for All Your MONITORING

Typical Scam DE-LINE annunciator cabinet showing plug-in and backlighted nameplate unit. Cabinets available in four standard widths, 3-5-7 or 11 alarm points wide, any number high.

Even the most advanced automatic system needs the reliable monitoring that only good annunciators offer. And of those available only Scam gives you the benefit of broad standardization and interchangeability to cover the most specialized requirements. For instance, the DE-LINE annunciator can provide, in one standard cabinet...

1. **Backlighted nameplates or bullseye indication.**
2. **Sequential alarm identification.**
3. **Easy adaption for use with Scam DU-ALL annunciators for HI-LO indication.**
4. **Optional ringback or manual reset functions by the operation of a slide switch.**

There are many other standard features of DE-LINE annunciators that are usually provided only on special order – features that make them the most versatile available, capable of "growing" with any control system. Write for literature or call any representative in the cities listed below.

THE SCAM INSTRUMENT CORP.

Chicago 18, Illinois
Phone IRving 8-9334

SALES REPRESENTATIVES:
Atlanta • Boston • Buffalo • Chicago
Cincinnati • Cleveland • Dallas • Detroit
Houston • Indianapolis • Kansas City
Los Angeles • Louisville • New York
Philadelphia • Pittsburgh • Portland
St. Louis • San Francisco • Seattle • Tulsa
Toronto and Vancouver, Canada

PIPING

Continued from page 194

formed on pipe sizes of 7 and 10 in. OD, wall thicknesses of 5/8 and 1 in.

The investigation gave considerable attention to details of joint design, machining dimensions and accuracy of fit-up. For consistent results, it was established that the internal diameters of matching pipe ends should be machined to provide essentially no offset or a minimum offset between the mating welding lands. The U-bevel type end preparation is found to produce the most consistent satisfactory results, but a heavier-than-standard welding land is favored when merely fusing the butted pipe lands. This is to produce a heavier initial weld bead and thus prevent burn-through on subsequent metal-arc passes.

To determine the suitability of the inert-arc first-pass technique on pipe material having wall thicknesses greater than 1 in., a special test was made on 3-in.-thick material, Fig. 3. The plates were scarfed with U-bevel and a standard insert-arc welding torch was employed to butt-weld the plates in the flat position shown. No difficulty was experienced in making the weld since the bottom of the groove was readily accessible and visible during welding with the torch and shielding cup size employed.

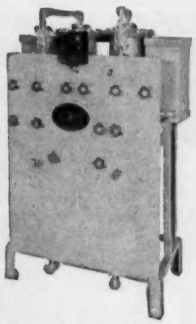
Although inert-arc welding of the root bead is not difficult to accomplish, its success depends largely on the skill of a trained welding operator. Strict adherence to proper technique, correct current settings and the ability to judge amount of penetration are of greatest importance. Protecting the weld's under side from the atmosphere during inert-arc welding of the first pass is an advisable and worth-while precaution. Although it was possible to obtain satisfactory bend-test results on welds made without this protection, as judged by *Code* requirements, the weld under side tended to scale and assumed a rough, uneven appearance. In contrast, inert-gas purging assured the weld a smooth, clean under side, free of all defects. Fig. 9 shows a comparison of inert-gas purged weld under side and a specimen made without purging.

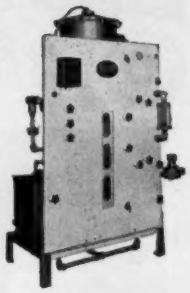
Inspecting the under side of inert-arc welds is not normally too difficult on shop fabrication work because most of the welds are accessible for direct visual inspection or can be reached with an optical instrument. However, for field erection the major problem is inaccessibility of the internal surface. For this, you must employ a special optical instrument that is inserted

ILLCO-WAY ionXchange

"PACKAGED" DE-IONIZERS

Right, standardized Model MB Mixed-Bed De-Ionizer available in four sizes for maximum flow rates ranging from 150 to 1000 gals. per hr.





Left, typical Model LU or HB Two-Bed De-Ionizer, each series made in six sizes covering maximum flow rates ranging from 150 to 1000 gals. per hr.

COMPLETELY ASSEMBLED AND TESTED AT FACTORY

If you can determine the capacity and flow rate you need, you can pick out a *ready-made* ILLCO-WAY unit that is all set to be hooked into your lines and go to work. Three series of models are designed to provide different degrees of water purification and different types of treatment, as required by individual situations. All models and sizes have been thoroughly time-tested and have proved highly satisfactory in hundreds of installations.

READY TO OPERATE AS SOON AS CONNECTED

Each one of these "packaged" De-Ionizers is assembled at the factory, the resins put in the tanks, and the completed unit given a working test. Then, without dismantling in any way, it is crated, and is ready for shipment. *For full details and specifications, write...*

ILLINOIS WATER TREATMENT CO.
ionXchange
ILLCO-WAY
840 CEDAR ST.
ROCKFORD,
ILLINOIS

NEW YORK OFFICE: 141 E. 44TH ST., NEW YORK 17, N.Y.
CANADIAN DIST: PUMPS & SOFTENERS, LTD. LONDON, ONT.

Tough Expansion Joint Problem?

Put the Badger Man on the Spot!

Complex expansion joint problems are *best* analyzed at only one place: your office or plant site. It's there alone that *all* essential data about your proposed installation is available.

And it's there — *on the spot* — that the Badger Man is ready to apply his unique abilities. He is a trained engineer *and* he brings to your problem the background of the world's most experienced manufacturer of expansion joints.*

Next time you are confronted with a complicated piping layout, severe operating conditions, unusual size and shape requirements — *any* complex expansion joint problem — put the Badger Man on the spot! His services are as close as your telephone.

COMING SOON — Badger Service-Rated Expansion Joints. Incorporate revolutionary new features developed during three years of intensive research and testing. Watch for this important announcement.

b m c

BADGER EXPANSION JOINTS

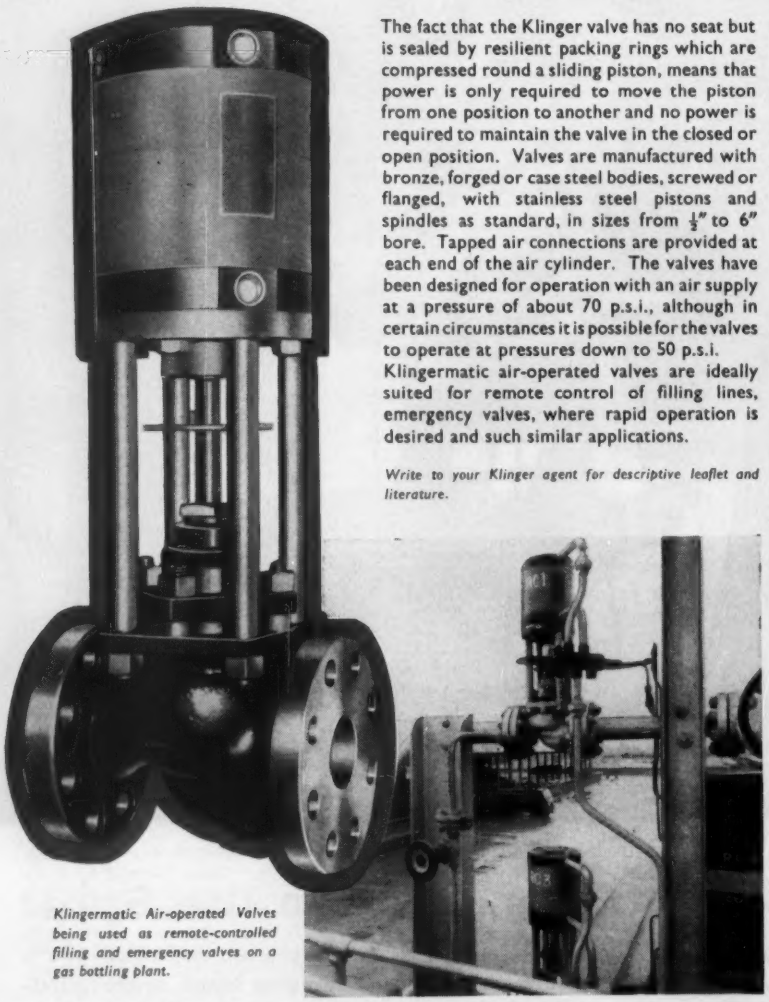
BADGER MANUFACTURING COMPANY

230 Bent Street, Cambridge 41, Massachusetts • 60 East 42nd Street, New York 17, New York

Representatives in principal cities

* Badger has been solving tough expansion joint problems for 50 years — a record unmatched by any other firm.

Klingermatic AIR-OPERATED VALVES



The fact that the Klinger valve has no seat but is sealed by resilient packing rings which are compressed round a sliding piston, means that power is only required to move the piston from one position to another and no power is required to maintain the valve in the closed or open position. Valves are manufactured with bronze, forged or case steel bodies, screwed or flanged, with stainless steel pistons and spindles as standard, in sizes from ½" to 6" bore. Tapped air connections are provided at each end of the air cylinder. The valves have been designed for operation with an air supply at a pressure of about 70 p.s.i., although in certain circumstances it is possible for the valves to operate at pressures down to 50 p.s.i.
Klingermatic air-operated valves are ideally suited for remote control of filling lines, emergency valves, where rapid operation is desired and such similar applications.

Write to your Klinger agent for descriptive leaflet and literature.

Klingermatic Air-operated Valves being used as remote-controlled filling and emergency valves on a gas bottling plant.

RICHARD KLINGER LIMITED, KLINGERIT WORKS,
Cables: Klingerit **SIDCUP, KENT, ENGLAND** *Tel: Foots Cray 7777*
AGENTS THROUGHOUT THE WORLD

Manufacturing Licensees for Canada
JOSEPH ROBB & COMPANY, LIMITED
5575, COTE ST. PAUL RD., MONTREAL, 20
Tel: WILBANK 3181 *Cable: ROBCO*
Branches at: SYDNEY, HALIFAX, OTTAWA, TORONTO, HAMILTON, WINNIPEG, EDMONTON, VANCOUVER, QUEBEC CITY.

Manufacturing Licensees for U.S.A.
The KLINGER CORPORATION of AMERICA
95, RIVER ST., HOBOKEN, NEW JERSEY
Tel: HOBOKEN 2-7915 *Cable: KLINGDALE*
Distributors and Agents in principal cities

MANUFACTURERS OF KLINGER SEATLESS PISTON VALVES; KLINGER SLEEVE-PACKED COCKS; KLINGER LEVEL INDICATORS; RINGS AND SEALS IN KLINGER SYNTHETIC MATERIALS AND KLINGERIT COMPRESSED ASBESTOS SHEET JOINTINGS AND PACKINGS FOR EVERY PURPOSE

PIPING

Continued from page 196

through radiographic survey opening.

Submerged-arc welding. The submerged-arc-welding process, Fig. 2, is used extensively for carbon-steel fabrication and lends itself well to shop pipe fabrication. But until fairly recently it has not been adopted for welding the chromium-moly alloy steels. To a great extent this resulted from the limited availability of wire of suitable composition for this application, but as filler-metal sources developed it became possible to study the welding and develop suitable procedures. Portable equipment has also been developed for field use. But like its counterpart, the stationary head used in shop fabrication, welding is only possible in the down-hand position, which somewhat limits its use.

Laboratory investigation of the chemistry and mechanical properties of deposited weld metal was the first phase of the welding study. The tests were conducted to establish a suitable filler-metal and flux combination for complete pipe-welding studies. The following variables were studied: (1) alloy filler wire and low manganese-bearing flux (2) alloy filler wire and high manganese-bearing flux (3) alloy filler wire and chrome-bearing flux.

After comparing the results for each of several combinations, the combination of alloy filler wire and "neutral" or low-manganese granular flux was preferred for welding the low chromium-molybdenum alloys. Further, this combination controlled more easily the deposited weld-metal chemistry. Table 8 shows typical undiluted weld-metal chemistry and room-temperature mechanical properties, as obtained with standard 0.505-in.-diameter tensile specimens for 1¼% chromium, ½% molybdenum and 2¼% chromium, 1% molybdenum alloy weld specimens using alloy wire and "neutral" flux.

Welding studies were conducted on pipe, with essentially the same procedure as for metal-arc welding so far as preheat, interpass temperature control, and post-weld heat treatment are concerned. These tests studied fused flux removal from the weld bead as a function of base-metal temperature and groove depth. Interpass base-metal temperature build-up was recorded as well as bead appearance of successive beads. Arc characteristics were established that produced beads of uniform and good contour and eliminated the possibility of "spill-over," that is molten metal break-through of the flux covering.

These studies showed that high base-metal temperatures affected ease of

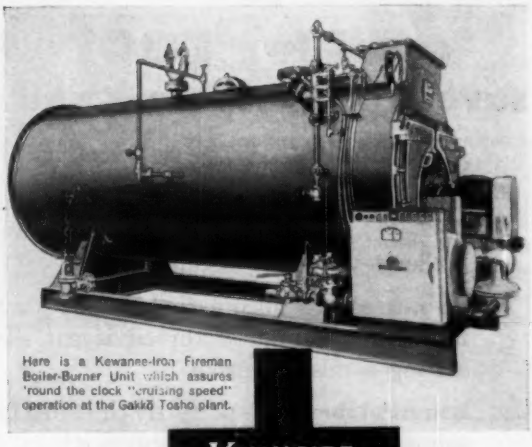
徐行

EAST MAY BE EAST . . . WEST MAY BE WEST . . .

but "*Cruising Speed*" boiler operation is best . . . *anywhere*

Gakkō Tosho Printing Company, Hara-machi Plant, Tokyo, Japan
Architect: Mr. H. Kishida and Mr. K. Tange, Tokyo, Japan
Engineer: Mr. K. Kawai, Toyohashi, Japan
Heating Contractor: Matsuhisa Industrial Company, Numazu, Japan

In Far Away Tokyo, Kewanee Boilers Were Selected by Gakkō Tosho Company Because They Provide Reserve Power to Meet Fluctuating Needs. No matter how you say it, in English or Japanese, "cruising speed" boiler operation adds up to the same thing in any language . . . higher efficiency, lower fuel cost, lower maintenance, less wear and tear, longer boiler life. And that's what management at Gakkō Tosho Company wanted in their modern Tokyo printing plant. So they selected Kewanee Reserve Plus Rated Boilers. Here they were assured reserve power to automatically supply steam quickly to operate automatic printing equipment. Reserve power in boilers means "cruising speed" operation . . . dependability . . . with enough power always on tap faster, surer. It means boilers rated on nominal capacity. Boilers rated on maximum capacity run at constant top speed, pile up maintenance and fuel costs—cut boiler life. Next time, choose Kewanee Boilers. Just call for the Kewanee man—in English, Japanese or Sanskrit—and he'll come running to serve you. KEWANEE BOILER DIVISION of AMERICAN-STANDARD, 101 Franklin Street, Kewanee, Illinois



Here is a Kewanee-Iron Fireman Boiler-Burner Unit which assures 'round the clock "cruising speed" operation at the Gakkō Tosho plant.

KEWANEE
reserve plus rated

KEWANEE BOILERS

You can depend on Kewanee engineering

Nearest Thing
to Machine Pipe Threading

RIDGID

Jam-Proof 65R
saves you time, work and mistakes

Ready for work fast—you set 65R to pipe or conduit size in 10 seconds . . . self-contained 1″, 1¼ ″, 1½″, 2″ high-speed steel dies. Self-centering workholder sets to size instantly.

No mistakes—automatic kick-out prevents jamming when standard thread is cut. Workholder setting is mistake-proof.

Beautiful threads—perfectly threaded factory test sample in your new 65R proves it!

You can't beat RIDGID 65R for speed, easy work and long service. *Buy it at your Supply House!*

RIDGID
Work-Saver Pipe Tools

The Ridge Tool Company, Elyria, Ohio, U. S. A.

PIPING

Continued from page 198

slag removal, but did not affect weld quality. From this, a preheat temperature at the lower end of the established temperature range was found desirable since base-metal temperature would build up as welding progressed. This is in contrast to metal-arc welding where the slower operation results in the base-metal cooling between weld passes, thus necessitating *high* initial preheat.

Stress-relieved pipe joints, tested in accordance with ASME and ASA *Codes*, produced satisfactory mechanical test results for procedure qualification. These results were further substantiated by metallographic studies, additional mechanical tests and radiographic examination.

Production-quality control. Developing and qualifying welders for important pressure-piping fabrication requires a training period that depends on individual ability and capability. Not all welders are capable of performing the quality of work required and a careful initial screening of men is necessary. This is an important function of shop supervision.

Hydrostatic pressure tests and inspection are carried out in the shop, as required by *Code* and customer specification. In addition, periodic radiographic checks are conducted on completed assemblies to assure a sound product and as further control on welder and electrode performance.

In connection with radiographic examination of field welds of the heavy-wall forged and bored piping of 2¼% Cr, 1% Mo steel, the problem of suitability placing the radiographic source inside the pipe, through a small survey hole to obtain satisfactory definition in the films, was solved in 1949 by developing the patented device in Fig. 7. With this equipment it became possible to insert radium through only a ½-in. IPS tapped hole near the weld and to locate the capsule accurately in any position adjacent to the weld from the outside by an indexing head. Films placed around the outside can be exposed under favorable conditions.

Maximum focal distance is obtained by placing the capsule against the weld and exposing a section of the weld in the area opposite or on the far side. With the unusually heavy wall in the piping, it became necessary to provide a method of increasing the focal distance beyond that obtained when the capsule is placed in the center of the pipe, as is common practice with lighter-weight pipe.

Other materials. Although this article has dealt only with the welding

Snow doesn't melt over GILSULATE® covered underground steam lines

Steam line with 5" partial dirt backfill—steam turned into line. A light snow fell during the evening and still remained late the following day.

Indianapolis Power & Light Company chose GILSULATE for a recent installation on a busy downtown Indianapolis street. In addition to its outstanding insulating efficiency—snow didn't melt over a partially insulated line—and corrosion protection, GILSULATE's high loading capacity makes it the ideal choice for such an installation. The 6" line runs for 185 feet directly under the sidewalk, at an average trench depth of 4'6".

Nine tons of GILSULATE (type B for 300-385° F. temp. range) were used; only 100 man-hours were required to complete the job exclusive of excavation and backfill.

More and more, architects, engineers and contractors are discovering the *versatility* of GILSULATE.

For schools, railroads, hospitals, airports, utilities, housing projects—for big jobs or small—GILSULATE provides permanent corrosion protection for hot underground pipes at a cost far below that of any other pipe insulation system.

Investigate the value of this dependable, easily-installed, low-cost GILSULATE. Use the coupon below or see your local GILSULATE distributor.

FACTS ABOUT GILSULATE

1. **EASY TO USE**—just pour and tamp...pipe heat does the rest.
2. **FORMS 3 ZONES** of protection against heat loss and all hazards commonly encountered by hot buried pipes.
3. **NEEDS NO HOUSING OR MECHANICAL SHEATHS:** no mixing, special handling or equipment.
4. **ONLY NEEDS NORMAL PIPE SPACING:** for multiple pipe or cramped conditions.
5. **THREE TYPES AVAILABLE:**
   Type A for 220°-300°F. temp. range
   Type B for 300°-385°F. temp. range
   Type C for 385°-520°F. temp. range

THE TRIPLE-ZONE INSULATION FOR LIFETIME PROTECTION OF HOT UNDERGROUND PIPES

GILSULATE®

AMERICAN GILSONITE COMPANY, SALT LAKE CITY 1, UTAH
Affiliate of Barber Oil Corp. & Standard Oil Co. of California

American Gilsonite Co.
134-F West Broadway, Salt Lake City 1, Utah
or
1145 East Jersey St., Elizabeth 4, N. J.

Send me more information on GILSULATE Insulation

NAME .....

TITLE .....

COMPANY .....

ADDRESS .....

P

With Dependable COFFIN Turbo Feed Pumps

Matched pump, turbine and gov... precision built as an in... ...ernor are compactly designed and pre-ance... ...integral unit to assure years of dependable perform-...in minimum size, with low steam consumption. Widely used for boiler feed service in refineries, chemical plants, paper mills and general industry, the well-known line of Coffin Turbo Pumps offer Volumetric Ranges to 800 gpm, Discharge Pressures to 1500 psig, Steam Temperatures to 950° F., Exhaust Pressures to 200 psig, and Liquid Temperatures to 325° F. For special installations these ratings may be exceeded.

ENGINEERS . . . write today for complete specifications on the ...o Pumps.

THE COFFIN ... TURBO ... PUMPS COMPANY

326 South Dean Street, Englewood, New Jersey • Cable Address: COFCO
Representatives in the United States, Canada, Europe, and the Far East

PIPING

Continued from page 200

of the chromium-moly alloys, our laboratories are carrying out studies on other ferritic materials and austenitic alloys. At present, the austenitic chromium-nickel stainless-steel materials for high-temperature steam service are one of the most pressing problems in the pipe-fabrication industry. Though apparently sound welds can be produced and procedure qualification carried out successfully in accordance with *Code* requirements, weld soundness at completion of the joint appears to be no criterion for troublefree pipe welds.

Industry's experience in the last few years shows the need for thoroughly evaluating welded joints in the chromium-nickel austenitic materials for high-temperature steam service. Reason: appearance of cracking in the weld and adjacent base metal after relatively short periods of service.

DIESEL STARTING

Continued from page 117

decompressor gear holds the valves open until the engine is up to speed. This reduces load on the starter motor.

AIR MOTORS

Reciprocating or vane-type air motors sometimes replace electric starters. Like electric motors, these connect to the engine through a Bendix or other type disengaging gear.

Advantage of this method: You do need room in the engine cylinder ...or air valves, and there is no ...fect caused by expansion of not ... air through the cylinder. head ... ...re often directly inter-ccoling ... standard makes of the starting ... ...s. The advantage ... Air motors ... that they are changeable with ... ...erature, and electric starting moto... ...r storage over electric starting ... ...tically little affected by low temp... ...ing maintaining the compressed-a... system and compressor (pra... identical with that in the direct sta... system) may be less costly than main... taining batteries.

Some air-motor types may give trouble at low temperatures because of moisture freezing as the compressed air expands through the motor.

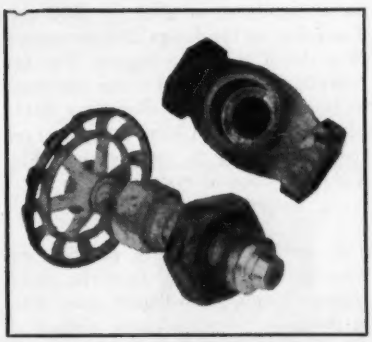
If a motor operating on 75-psi air can be fitted and given adequate starting torque, you can supply it from a regular shop air line.

Gas-cartridge starter. The Williams and James Company of Great Britain manufactures an air-starting motor that operates either by compressed air or by a gas-producing cartridge. The cartridge resembles an oversize shotgun

"I got 5 years of service from a valve I expected to last only 90 days"

Mr. C. L. Worthington, Chief Engineer for E. L. Bruce Co., Little Rock, Arkansas plant, standing near a Walworth No. 225P Bronze Globe Valve with "500 Brinell" stainless steel seats and discs that was installed in severe boiler blowdown service. Hardened seats and discs are especially resistant to wire drawing, steam cutting, or galling.

Some time ago Mr. C. L. Worthington, Chief Engineer for E. L. Bruce Co. plant at Little Rock, Arkansas, was having valve trouble on some newly installed boilers. The first boiler to go in service generated 600 hp operating at 200-pounds pressure. The water was so bad that a hot lime and soda ash water softener treatment had to be used, and it was necessary to add other chemicals to this solution from time to time. Mr. Worthington wanted to use a continuous blowdown to skim off the worst part of the scum on the water. He installed a small blow pipe about an inch below the normal water level in the boiler. This worked well, except that the one-inch valve on the line could only be partially opened and let a small part of the scum be blown off at one time. If the valve was widely opened, it would not take long to lower the water level in the boiler and run the steam pressure down. This service gave Mr. Worthington lots of valve trouble, as can well be imagined, because of the extreme wire drawing that occurred.



A Walworth No. 225P Bronze Globe Valve that gave perfect performance for four years and 362 days in a severe boiler blowdown service where the Chief Engineer said he had never been able to keep a valve more than 60 to 90 days.

One day the Walworth representatives in that area, called upon Mr. Worthington and demonstrated the outstanding features of the Walworth No. 225P Bronze Globe Valve. This valve, which has a working steam pressure rating of 350-pounds at 550°F, has a plug-type stainless seat and disc which has been heat treated to a minimum hardness of 500 Brinell. After listening to the Walworth men and examining a 225P valve, Mr. Worthington agreed that he would try one in the severe service described. He said if it lasted 90 days, he would consider that it had done a good job.

The valve went into service and came out within three days of being in service five years under very severe operating conditions. The valve was used 24 hours a day from early in the morning on Monday until Saturday night, when it was closed until the following Monday morning. It was never opened more than three-quarters of a turn, and most of the time it was opened only one-half to one-quarter of a turn. For the life of the valve, nearly five years, it never failed to give a 100% closure when shut on Saturday night until opened Monday morning.

When another 600 hp 200-pound pressure boiler went into service, it also was equipped with a one-inch Walworth No. 225P Bronze Globe Valve on the same service.

In view of the severe service and the wire drawing to which this valve was subjected, it is interesting to note that the original valve (which was taken out of service almost five years after it had been installed) was removed – not because the seat and disc were wire drawn – but because the turbulence of the steam had finally caused a small hole to occur in the wall of the body of the valve. Needless to say, the valve that was taken out of service was replaced immediately by another one-inch Walworth No. 225P Bronze Globe Valve, positive assurance that Mr. Worthington is satisfied that this valve has "done a good job."

Other Walworth products include complete lines of Gate, Globe, Angle, Check and Lubricated Plug Valves in bronze, iron, steel, stainless steel and special alloys. Complete information and literature will be furnished upon request.

WALWORTH

60 East 42nd Street, New York 17, New York

SUBSIDIARIES: ALOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION M & H VALVE & FITTINGS CO. SW SOUTHWEST FABRICATING & WELDING CO., INC. WALWORTH COMPANY OF CANADA, LTD.

Here's Why Aeromaster Fans mean more satisfactory cooling equipment operation

Manufacturers and users of cooling equipment agree... Aeromaster Fans give outstanding service. Here are the reasons why.

Aeromaster Fans are *precision engineered,* adapted from high speed aircraft propellers. They have adjustable blade pitch and anti-flutter design . . . therefore, require less horsepower. And they last longer too, thanks to the exclusive Aeroloid blade coating to resist acids and alkalies, abrasion and weather. Overall result: Aeromaster Fans *give more cooling at lower cost.*

Available in 4, 6, or 8 blade styles, in diameters of 5 to 24 ft., with capacities up to 1,000,000 cubic feet per minute, all Aeromaster Fans are fully guaranteed.

Koppers also has trained engineering specialists available in principal cities, insuring prompt, expert Aeromaster Fan service. And Koppers is always ready to consult with you on special fan problems. Next time you plan a replacement of present fans, specify Aeromaster. And when you consider new equipment, call on Koppers . . . always eager to be of service.

Aeromaster Fans

KOPPERS

METAL PRODUCTS DIV. • KOPPERS COMPANY, INC. • BALTIMORE, MD. • This Koppers Division also supplies industry with Fast's Couplings, American Hammered Industrial Piston and Sealing Rings, Koppers Electrostatic Precipitators and Gas Apparatus. *Engineered Products Sold with Service*

MAIL COUPON TODAY FOR COMPLETE INFORMATION

KOPPERS COMPANY, INC., *Aeromaster Fans,* 2607 Scott St., Baltimore 3, Md.
Gentlemen: Please send me detailed information on Aeromaster Fans for

_____
(name and type of equipment to be cooled)

Name _____

Title _____ Company _____

Address _____

City _____ Zone _____ State _____

DIESEL STARTING

Continued from page 202

shell filled with a very slow-burning powder. It is inserted in the breech of a "gun" attached to the air-motor inlet. When fired, gas passes through a throttling orifice into the air motor turning the engine for two or three seconds. If the engine fails to fire, another cartridge is used.

A variation has a cylinder like a revolver's so no time is lost in keeping the engine rolling. A relief valve or a bursting disk prevents dangerous pressures from building up if the engine fails to turn over.

This arrangement may be fitted instead of a compressed-air system, or provided as an emergency standby if air pressure is lost. Fig. 3 shows the cartridge and gun.

The Coffman gas-cartridge starter, also of British manufacture, uses a similar cartridge. Gas discharges into a cylinder whose piston rotates a central shaft by means of helical splines. This causes the shaft to turn 15 or so times. The force is so great that the starter can be attached directly to the engine crankshaft. This starter is light, compact and remarkably effective. But the inertia forces produced are so great that it is suitable only for small-bore high-speed engines.

HYDRAULIC MOTORS

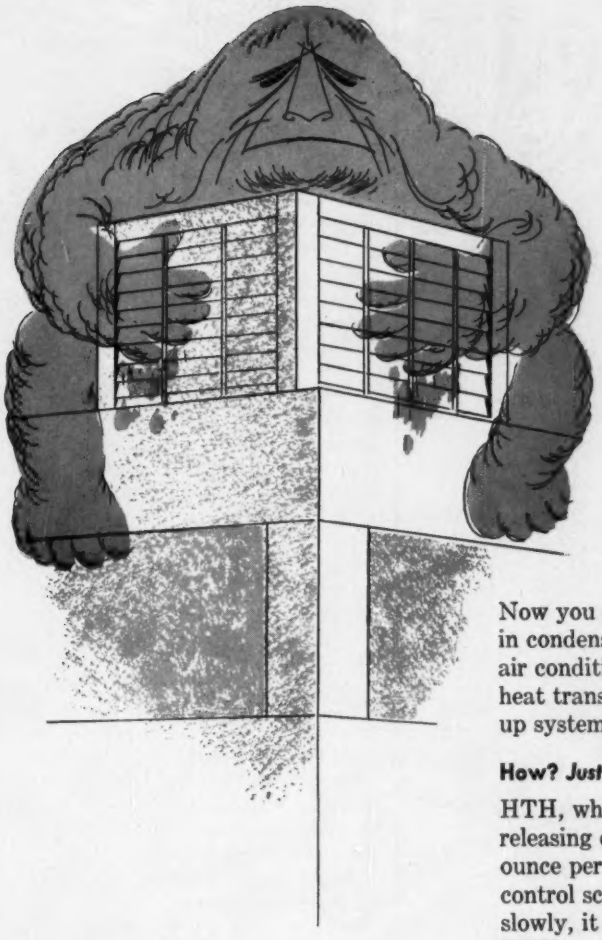
Hydraulic motors may be used in place of electric- or air-motor starters. If the oil has appropriate viscosity, temperature does not affect the system. An engine or motor-driven pump charges an accumulator to 2500 to 4000 psi, depending on the design, and the energy thus stored turns the engine. The accumulator is preloaded so the minimum hydraulic pressure is about two thirds of the maximum. A hand pump charges the accumulator in emergencies. Fig. 4 shows a typical system.

GASOLINE MOTORS

A small hand-starting gasoline engine may be fitted to turn the diesel through a clutch and Bendix gear. This is the most certain starting method of all. It is particularly suitable for cold weather. The water jacket of the gasoline engine may be connected to that of the main diesel so the starting engine can warm the diesel.

In addition, the gasoline engine can go on cranking indefinitely without recharging. It is practically unaffected by temperature.

The main disadvantages are that it may take some time to start the gasoline engine, let it first warm itself and then the diesel; also, it may not be convenient to store gasoline.



HTH® rids water systems of green scum

Now you can eliminate troublesome algae growths in condensers, spray towers, cooling ponds, reservoirs, air conditioning equipment . . . algae growths that cause heat transfer loss, produce offensive odors, and clog up systems using recirculated water.

How? *Just use HTH Granular.*

HTH, when added to water, dissolves quickly, releasing chlorine to provide sure, fast algae kills. One ounce per 1000 gallons of water is generally sufficient to control scum growths. Because these growths form slowly, it is only necessary, in most cases, to add HTH periodically or as a "shot" treatment to obtain the desired results. Frequency of application depends on the nature and condition of the specific water supply.

HTH is dry, stable, easy to use. Containing 70% available chlorine, it is packed in 100-lb. drums and in cases of nine 5-lb. cans. Get all the facts about this safe, effective, economical way to prevent algae growths. *Mail the coupon today.*

MATHIESON

OLIN MATHIESON CHEMICAL CORPORATION
Industrial Chemicals Division
Baltimore 3, Maryland

Please send me full information on the use of HTH to prevent algae growths.

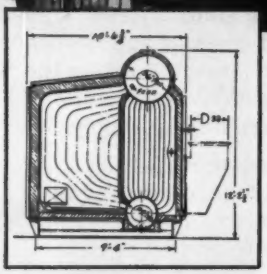
Name_____ Title_____

Company_____

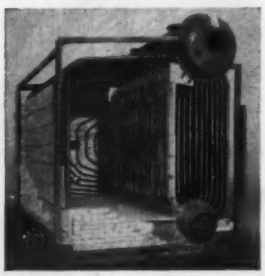
Address_____

_____

3734



Here's Bigelow's new, "one-piece" answer to a wide range of steam problems. This water-tube "packaged" boiler includes burner, forced-draft fan, feed water regulator, soot blower, valves, refractory, insulation, controls and accessory equipment. It is shipped complete—ready to operate as soon as service connections are made.



Type H boiler in process of shop assembly.

Advantages

Cuts Installation Costs and Time... Requires Small Space... Portable... Simple To Operate... Fast Steaming With Safety, Efficiency and Economy... Low Maintenance... Handles Quick Load Changes Easily and Efficiently... Wide Range Of Service... Burns Oil or Gas.

Available in standard sizes for capacities ranging from 8,000 to 30,000 lbs. of steam per hr. Write for complete catalog.

THE BIGELOW COMPANY • NEW HAVEN 3, CONN.

BIGELOW REPRESENTATIVES: Boston • New York • Chicago • Greensburg, S. C. • Philadelphia • Syracuse • Detroit • Washington, D. C. • San Francisco • Los Angeles • Atlanta • Milwaukee • New Orleans • Petersburg, Va. • Seattle • Indianapolis • Kansas City, Mo. • Tulsa • Salisbury, Md. • Greensboro, N. C.

NUCLEAR DATA

Continued from page 95

Investment. Table 3 lists rough estimates of plant first costs. No allowance has been made for special research and development design work that might be needed for the reactor plant. The cost data include both equipment and installation and erection costs.

Reactor building (140-ft sphere) includes pile and foundation work and materials, steel sphere, sphere internal concrete shielding and steel structure, testing, special sealed doors, crane, painting, etc.

Reactor equipment includes reactor vessel and plug, secondary containment tank, supporting steel, fuel-element transfer equipment, preheating equipment, leak detection, control equipment, moderator material, etc.

Coolant systems includes sodium pumps, main piping, intermediate heat-exchanger units, steam generators, piping and equipment preheating, secondary containment, leak detection, insulation, foundation, etc.

Auxiliary equipment and facilities include fuel-element fabrication apparatus, hot laboratory, physics and chemistry laboratory, reactor-plant instrumentation, reactor-plant electrical systems, inert-gas systems, auxiliary liquid-metal systems, hot shipping facility, reactor machine shop.

Steam-electric building houses turbine plant, combined control room, steam-generator units, turbine-room crane, etc.

Steam, feedwater, circulating-water systems include main steam and feedwater piping, circulating water piping, condenser, associated auxiliaries, feedwater heaters, boiler feed pumps.

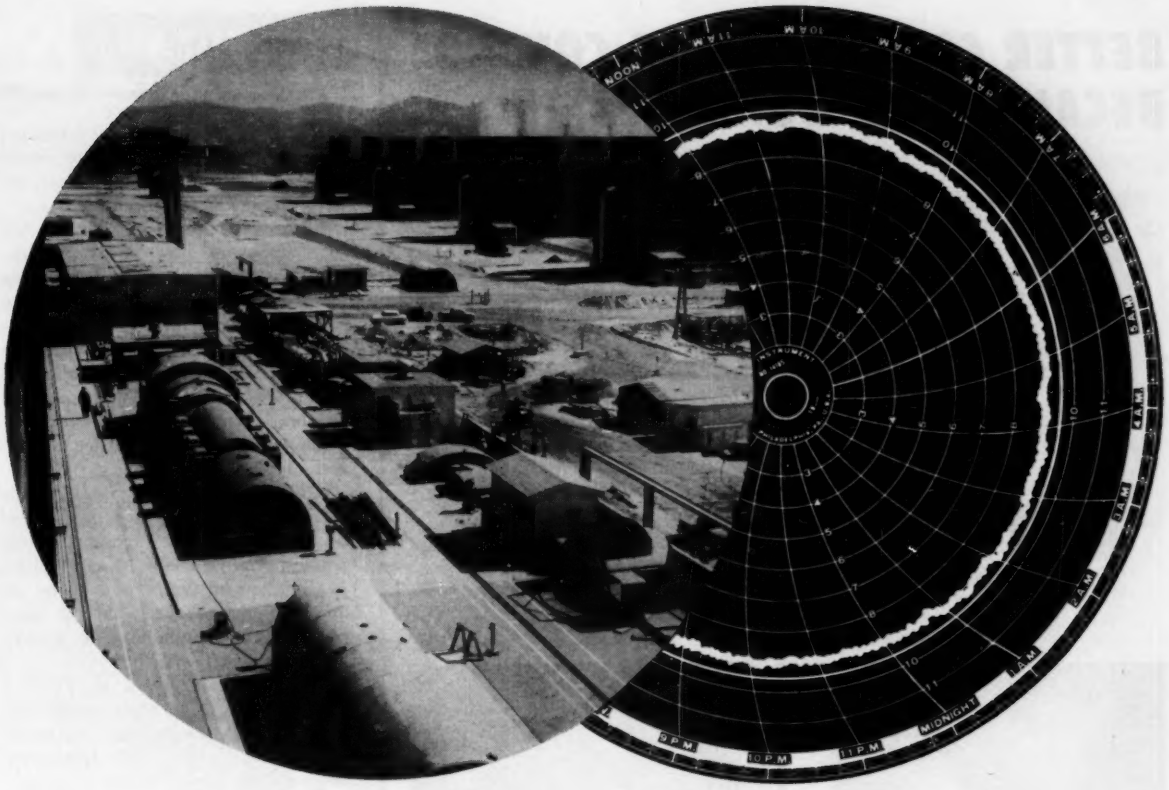
Electrical equipment includes bus bars, controls, switchgear, transformers, switchyard facilities and transmission tie-in systems.

Auxiliary equipment includes instrumentation and controls, steam dump systems, compressors, plant service piping, etc.

Site improvements cover dredging, fill, grading, railroad facilities, roads, storm and sanitary sewers, fences, yard lighting, etc.

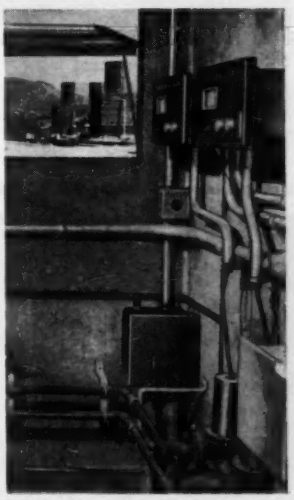
Total plant investment of $55,300,000 for 190-mw capacity gives a unit cost of $291 per kw. This is high compared to a typical cost of about $150 per kw for a conventional modern fuel-fired plant of equal rating. To draw valid conclusions on feasibility of nuclear power plants, however, we must build and operate several of them.

Operation and economics. Unique feature of the nuclear power plant is the controlling role the reactor plays in fixing start-up and shutdown times and the load swings the plant can accommo-



San Fernando Valley Steam Plant checks corrosion with 18 Beckman pH Control Systems

WATER SYSTEM	NO. OF BECKMAN UNITS	pH RANGE	REASON FOR pH CONTROL
Raw Water Demineralization	2	8.0-9.0	Properly condition raw Owens River water.
Boiler Makeup Condensate	4 4	11.0-11.3 8.5-9.0	Prevent corrosion in wet stages of turbine and condensate systems.
Condenser Circulating	4	7.5-8.0	Protect efficiency, prevent corrosion, scale, deterioration in condensers, heat exchangers, cooling towers.
Turbine Bearing Cooling	4	7.5-8.0	Prevent corrosion, scale and algae deposits in turbines, piping and cooling towers.



Nowhere is the need for accurate and reliable automatic pH control more dramatically illustrated than at the 512,500 KW Valley Steam Plant, newest and largest power-generating facility of the Los Angeles Department of Water and Power. To prevent shutdowns and high maintenance and replacement costs, 18 individual Beckman pH systems help treat the plant's major water systems properly to avoid destructive corrosion, scale and deterioration in turbines, boilers, condensers, piping and cooling towers.

Exactly how Valley Steam uses Beckman pH instrumentation is outlined in the chart above. Valley Steam is one of the first power plants to use a centralized chemical control system whereby all boiler, and condensate sampling and treatment is done automatically from a single location. Reliable instrumentation here is vital.

Valley Steam Plant, serving residents of Southern California, relies on rugged and accurate Beckman pH measurement and control instrumentation for top operating efficiency today – and tomorrow. To learn how Beckman pH control can help you, mail the coupon today.

Beckman® / *process instruments*

Beckman Instruments, Inc., Process Instruments Dept., Fullerton, California

☐ Please send me a pH System Analysis Form that will entitle me to a free engineering analysis and recommendation for solving pH problems at our plant.

☐ Please send me a copy of "Industrial pH Measurement and Control" and add my name to your mailing list to receive additional information on pH control.

Name: _____ *Title:* _____

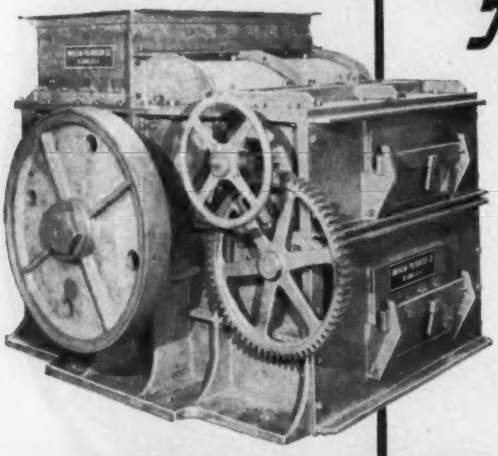
Firm: _____

Street: _____

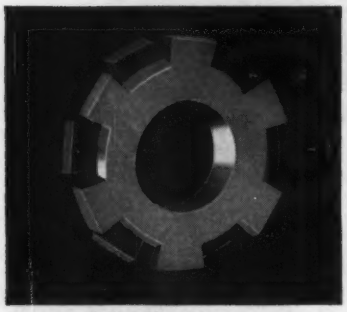
City: _____ *Zone* _____ *State* _____

N15-77

BETTER COAL CRUSHING CONTROL BECAUSE IT'S BUILT BETTER . . .

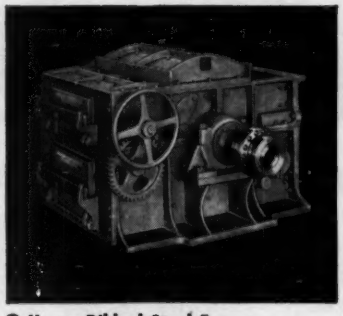


American ROLLING RING COAL CRUSHERS



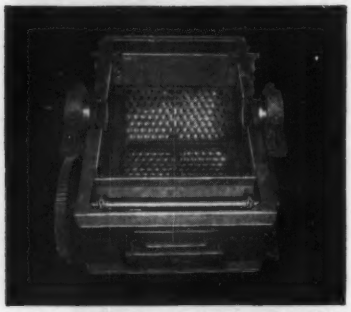
1 Patented Shredder Ring

American-originated feature that splits coal instead of smashing it—for uniform sizing, minimum fines. Result: Americans run at slow speeds, with savings in power and maintenance. No cams, shear pins, toggles.



2 Heavy-Ribbed Steel Frame

Bearing pedestals are cast integrally with lower side frames. Sectional design for easy dismantling . . . abutting joints accurately machined and bolted together for dust-tight fit.



3 Completely Lined Crushing Chamber

Heavy, renewable liners . . . sectional for easy plate-at-a-time replacement . . . engineered to offer life-time protection to the frame.

4 Complete Accessibility to Adjustment and Parts

All adjustments external—even with crusher in motion. Rotor easily reached by removing top section. Rings readily reversed or replaced. Liners quickly reached, too, for periodical inspection.

WRITE for Coal Crushing Bulletin

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE. • ST. LOUIS 10, MO.

NUCLEAR DATA

Continued from page 206

date. The thermal gradient and thermal stress problems in the reactor vessel and associated piping and heat exchangers cause these limitations.

A steam-dump system minimizes the effect of severe load swings on the reactor plant. Start-up and shutdown times depend on the maximum permissible rate of temperature change in the reactor systems. For a start-up from 600 F, this could mean a minimum start-up time of seven hours based on maximum rate of change of 50 F per hr and a reactor sodium outlet temperature of 950 F.

During the first year or two, the plant factor would be low because of testing and unexpected equipment outages, especially in the reactor plant. The 80% plant factor should be attained by at least the second or third year for a plant built with today's technology.

Operating costs shown in Table 4 include: (1) fuel-inventory charge (2) spent-fuel processing and waste-disposal charge (3) fuel-fabrication charge (4) fuel burn-up cost (5) operating and maintenance labor (6) supplies and miscellaneous (7) fixed charges at 13%. The second item includes only the cost of processing spent fuel and concentrating and preparing the radioactive waste for disposal. Item (4) is based on replacing the fuel without any credit or consideration being given for the depleted material recoverable from the spent-fuel processing. The cost of natural uranium has been assumed at $27 per pound.

Estimated net energy cost in the switchyard figures at 8.9 mills per kwhr. This compares with a national average in steam plants of about 7.8 mills per kwhr.

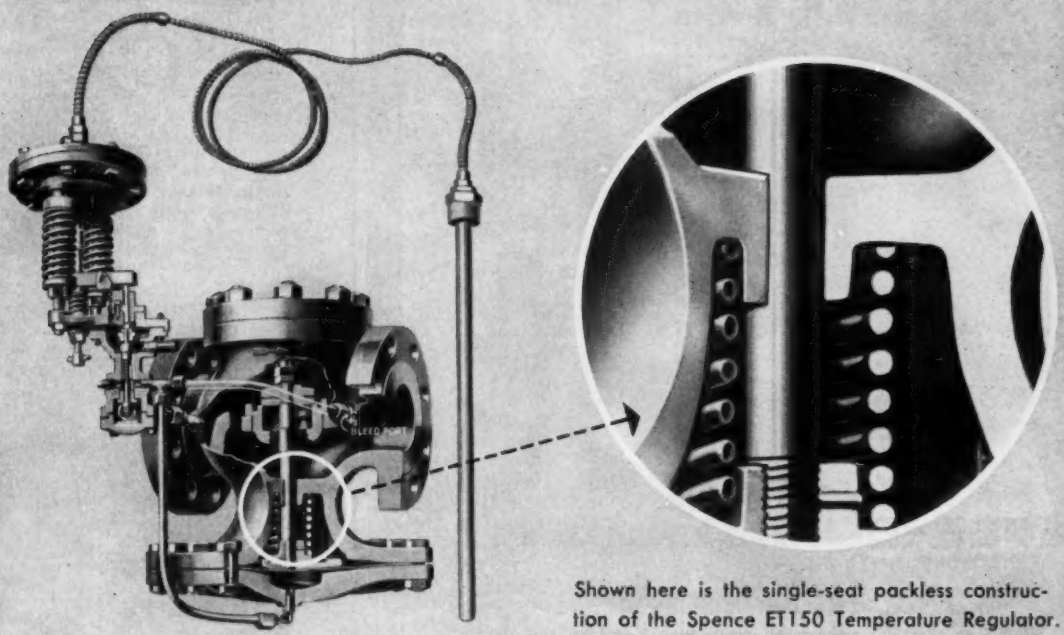
Conclusions. We, the authors, sincerely hope that all the material in this study course has given you, the reader, a better understanding of the fundamentals and problems of designing nuclear power plants. We want to caution you strongly that the design we have just been talking about has been greatly simplified to emphasize the main points.

Finally, other things being equal, the cost of generating power will determine the selection and location of any future nuclear power plants for producing electric energy.

Caution: The reader should note that no effect has been considered in the calculations for: (a) conversion of U-238 to Pu-239 (b) fissioning of Pu-239 nuclei. Both these items would lower fuel cost, energy cost, and should be considered in an actual plant.

VALVE TIPS:

Advantages of Packless Construction in Temperature Regulating Valves



Shown here is the single-seat packless construction of the Spence ET150 Temperature Regulator.

One of the biggest headaches in regulating valve maintenance is repacking stuffing boxes.

How often a valve needs repacking, how much time it takes, and the cost of the system downtime all vary with the construction of the regulator and the service it's used for. No matter how you calculate all these variables it's still a headache—and an expensive one.

In the temperature regulator shown above (Spence Type ET150) stuffing boxes are eliminated. This is done by what is known as "balanced" diaphragm construction. You can see in the cutaway drawing that pressure is applied to both sides of the large metal diaphragm. The upper side is exposed to delivery steam pressure and the lower side is exposed to loading pressure applied by the pilot. When the pilot closes, both delivery pressure and loading pressure are equalized through the bleedport and connecting tubing.

This construction not only does away with repacking problems, but it makes possible additional savings as well. For example, you will note in the sectional blow-up that this design eliminates a closely fitted stem and guide. Dirt or other foreign matter doesn't have much of a chance to lodge between these parts and cause sticking.

Another cause of binding or sticking, uneven expansion of closely fitted parts, is also eliminated with this design. In addition, valve stem wear is reduced for the same reason.

Lower maintenance is not the only advantage of this packless construction. Accuracy of regulation is also improved because friction due to a stuffing box, dirt, or uneven expansion is not a problem. The large, balanced metal diaphragm is more sensitive to slight changes in pressure.

Guaranteed Not To Wiredraw

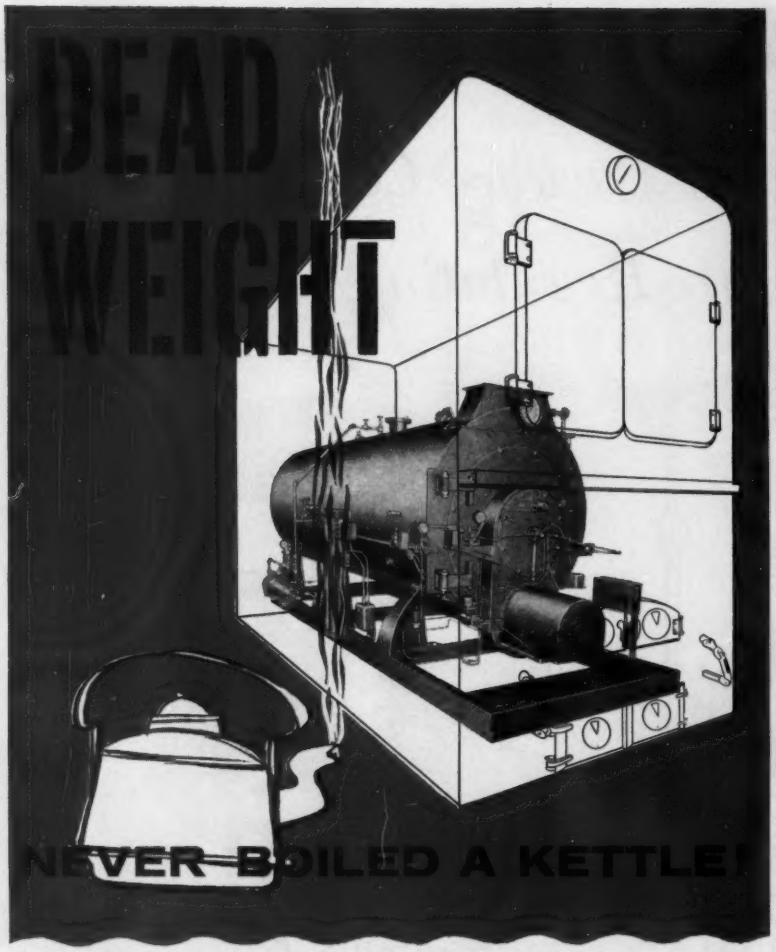
If seats and discs are cut by steam (wiredrawn) the loss of steam through these grooves can be another expensive item — directly charged against the regulating valve. Fortunately, you can eliminate these costly leaks by specifying a temperature regulator that is *guaranteed not to wiredraw.*

Spence makes such a guarantee because their seats and discs are made of SECO Metal. Over 20 years experience with this special alloy has failed to produce a single case where a SECO Metal seat or disc had been cut by steam. All that's required is an approved strainer located ahead of the regulating valve. Expensive steam leaks just can't happen with this combination of SECO Metal and single-seat design.

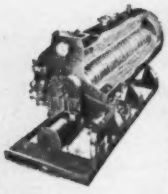
If you would like to have more information on Spence Temperature Regulators, drop us a line and ask for Bulletin T150. It gives more detailed information on these and other Spence design features. Piping layouts and helpful information on the installation of temperature regulators are also included. Write for your copy today.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

SE 140



THERE'S no practical *use* for the excess weight and bulk of the conventional steam and hot water generator, with its maze of tubes, passes and refractory baffles. The Cyclotherm design incorporates just 2 passes to give you a guaranteed minimum efficiency of 80%. Complete combustion with uniform heat-transfer in the first pass utilizes approximately 65% of your fuel value; the balance is transferred in the second pass. *Fifty* passes would accomplish no more. Cyclotherm *is* compact—up to ⅓ smaller than other packaged steam generators.



CYCLOTHERM Steam and Hot Water Generators are designed, engineered and constructed in the Cyclotherm plant to give you the finest in packaged steam or hot water generators. Factory insulation with fiberglas plus aluminum jacket saves up to $600 in field-insulation. Every unit test-fired before leaving the factory. The Cyclotherm reaches you completely assembled — five simple connections and it is ready to go to work. No expensive stack required; no special foundation. Up to 50% saved in maintenance costs by simplified design and by electronic control system that automatically operates Cyclotherm as load requires.

MANY plants have installed two or more Cyclotherms for maximum flexibility and power. Cyclotherm stands back of its product with sales engineers close by whenever you need them. Fifteen models, from 18 to 500 hp (15 to 200 psi). For full information on a boiler that represents the most advanced engineering in steam generation, fill out the coupon and mail today.

YEARS AHEAD
IN STEAM
GENERATION
CYCLOTHERM®
Steam & Hot Water Generators

Cyclotherm Division
National-U.S. Radiator Corp.
2529 E. First St.
Oswego, N. Y.

Send me free copy of your complete booklet on Cyclotherm Steam and Hot Water Generators

More FREE LITERATURE

Begins on page 163

METERS AND INSTRUMENTS

10 **Test instruments** for testing and calibrating current actuated protective devices are described in catalog 3561. Contains product descriptions, application recommendations, illustrations, schematic diagrams and essential technical data of interest to public utilities and electrical maintenance personnel of large plants and industries. Multi-Amp Corp, 10 3rd St, Newark, N. J.

★ **Instruments** for electrical power generation are described in 34-p bulletin 9070. Includes dimension drawings and typical specs together with illustrations of methods used in power plants to centralize instrumentation. ★Request direct on company letterhead from Minneapolis-Honeywell Regulator Co, Industrial Div, Wayne & Windrim Aves, Philadelphia 44, Pa.

11 **Panel instruments** and accessories. Illustrated 12-p bulletin GEC-368H details the features, applications, construction, dimensions and other data of 2½, 3½ and 4½-in. sizes. General Electric Co, Schenectady 5, N. Y.

12 **Armored rotameters** are discussed in illustrated 12-p bulletin 130. Includes details of design and construction, capacity charts, principles of operation. Brooks Rotameter Co, Lansdale, Pa.

13 **Transmitting potentiometers** are subject of 4-p bulletin MTT810. Contains application data, design and operating specs, temperature ranges. Manning, Maxwell & Moore, Inc, Stratford, Conn.

PUMPS

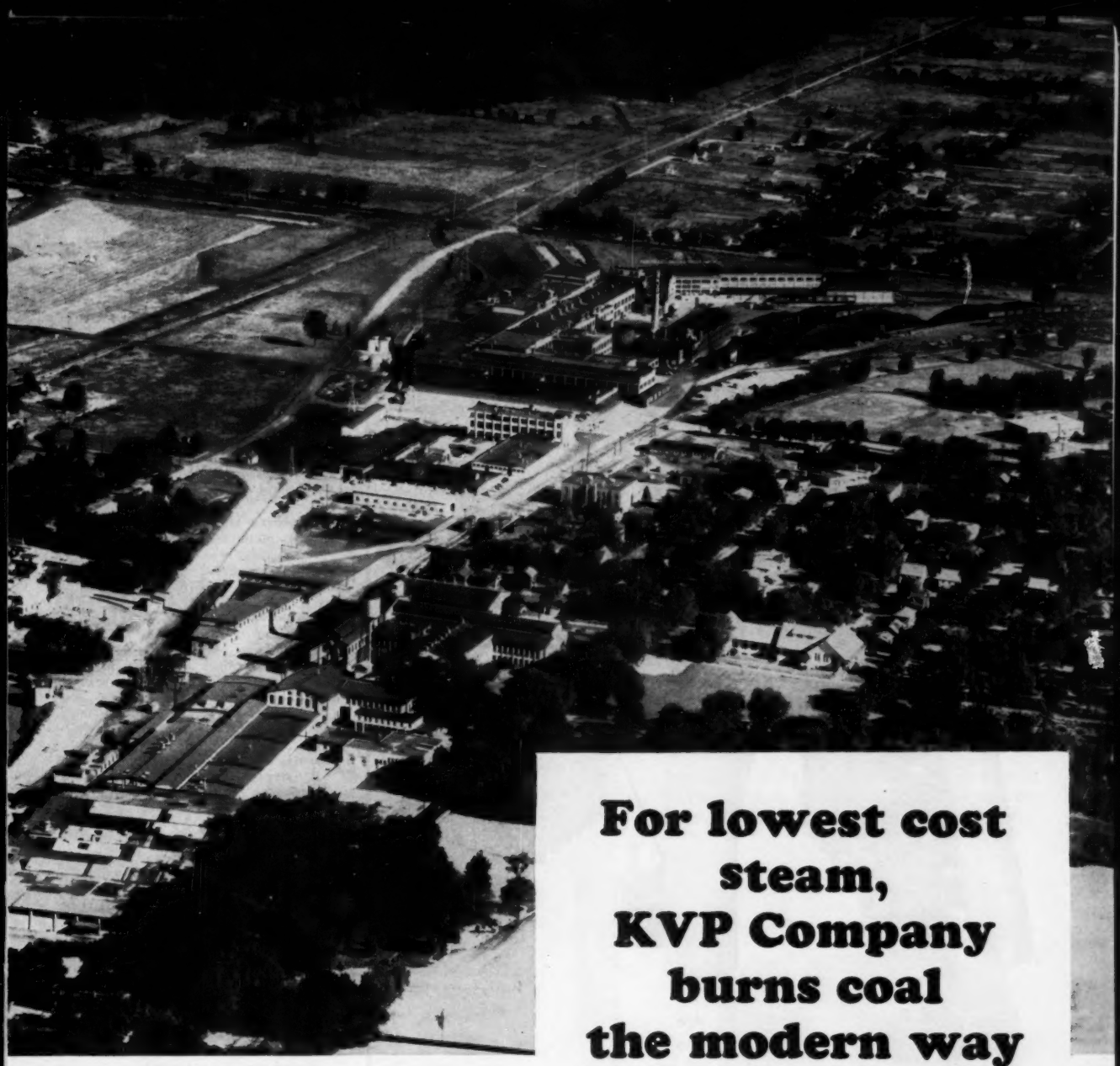
14 **Submersible pumps** ranging from 5 to 900 hp and from 30 to 30,000 gpm and above are described in 12-p bulletin. Construction and operation of pump, motor and seal (both mercury and mechanical) are shown in cutaway detail. Byron Jackson, Division of Borg-Warner Corp, Box 2017A, Terminal Annex, Los Angeles 54, Calif.

15 **Compound pumps.** Air - cooled units in ¼ to 3 hp sizes are detailed in 4-p bulletin 403. Lists construction features, describes operating characteristics. Kinney Mfg Division, The New York Air Brake Co, 3529 Washington St, Boston 30, Mass.

16 **Canned-motor pumps** for general process pumping are detailed in 4-p bulletin 1050. Contains performance curves, dimensions, construction and operation data. Chempump Corp, Station M, 1300 E Mermaid Lane, Philadelphia, Pa.

17 **Positive-displacement** pumps for metering and proportioning of small quantities of low-viscosity

(*Continued on page 212*)



For lowest cost steam, KVP Company burns coal the modern way

The engineering department of the Kalamazoo Vegetable Parchment Company, following an extensive fuel survey, decided to meet increased power demands by burning coal the modern way.

Five of eight existing coal fired boilers of varying age were replaced by one new boiler capable of burning a diversified range of coals. In addition, automatic coal handling equipment was installed. With it, coal is automatically dumped, magnetically cleaned, carried to the power house by a moving belt, crushed, pulverized and fed into the furnace.

These new facilities have resulted in increased steam capacity, lower operating costs and lower fuel costs.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

NATIONAL COAL ASSOCIATION
Southern Building • Washington 5, D. C.

Consult an engineering firm

Designing and building hundreds of heating and power installations a year, qualified engineering firms can bring you the latest knowledge of fuel costs and equipment. If you are planning the construction of new heating or power facilities—or the remodeling of an existing installation—one of these concerns will work closely with your own engineering department to effect substantial savings not only in efficiency but in fuel economy over the years.

facts you should know about coal

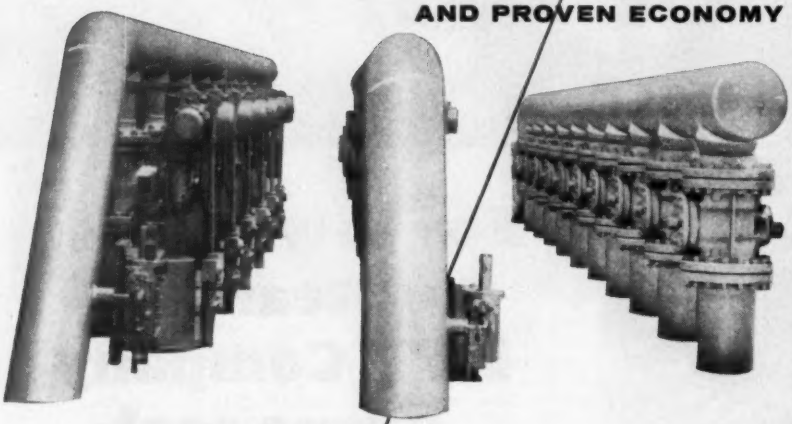
In most industrial areas, bituminous coal is the lowest-cost fuel available • Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar • Automatic coal and ash handling systems can cut your labor cost to a minimum. Coal is the safest fuel to store and use • No smoke or dust problems when coal is burned with modern equipment • Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

BRANCH
after
BRANCH
after
BRANCH
after
BRANCH
after
BRANCH

WELDOLETS

FOR ASSURED STRENGTH

AND PROVEN ECONOMY



WELDOLETS

THREDOLETS

SOCKOLETS

Are you effecting this economy for your company? Neat and uniform appearance is evident in code constructed weldolet headers in this crude oil pipeline terminal. The money saved is in the bank and does not appear in this picture. If you are not using the weldolet method of cutting piping costs, write today for information.

BONNEY

SOLD THROUGH LEADING DISTRIBUTORS

WELDING FITTINGS DIVISION

BONNEY FORGE & TOOL WORKS

350 GREEN ST., ALLENTOWN, PA.

More FREE LITERATURE

Begins on page 163

fluids are described in 8-p bulletin 300. Hills-McCanna Co, 2369 W Nelson St, Chicago 18, Ill.

WATER TREATMENT

18 **Iron and manganese** removal from water supplies is subject of comprehensive technical reprint T-144. Graver Water Conditioning Co, 216 W 14th St, N. Y. 11, N. Y.

19 **Practical systems** for process and waste-water treatment using controlled volume pumps to meter chemicals and additives are described in technical report 64. Milton Roy Co, Station L, 1300 E Mermaid Lane, Philadelphia, Pa.

20 **Activated sludge plants** for treatment of both domestic sewage and industrial wastes are described and compared in 12-p bulletin 6510-C. Infilco Inc, Tucson, Ariz.

21 **Industrial filtration** is title of illustrated 10-p bulletin 651. Presents case histories covering the filtering of city water to filtering of recirculation water from cooling towers and spray ponds. R P Adams Co, Inc, 311 E Park Drive, Buffalo 17, N. Y.

22 **Multicell filters** are described and illustrated in 4-p bulletin 5624. Contains full specs, operational data. General Filter Co, 925 2nd St, Ames, Iowa.

23 **Feedwater controller.** Illustrated 4-p bulletin 5623 contains details of operation and installation of unit, plus typical specs. C E Squires Co, 18502 Syracuse Ave, Cleveland 10, Ohio.

24 **Zeolite water softeners** with manual or automatic control, mixed- and multi-bed deionizers, filters, purifiers, degasitors, boiler and process water-conditioning systems, ion-exchange materials and water-treatment chemicals are described in bulletin 611C. Elgin Softener Corp, 130 N Grove Ave, Elgin, Ill.

25 **"Status of demineralizing** for treatment of boiler feedwater in today's power plants" is title of 24-p technical reprint T-140. Considers some developments, trends and applications of multi- and mixed-bed ion exchange — uses several case histories as examples. Graver Water Conditioning Co, 216 W 14th St, New York 11, N. Y.

26 **Water filters,** pressure-type, are subject of 12-p illustrated bulletin WC-107A. Describes uses, design features, engineering details of pressure sand and gravel filters. Graver Water Conditioning Co, 216 W 14th St, New York 11, N.Y.

MISCELLANEOUS

27 **Lubrication** and coolant systems. Illustrated 4-p bulletin 1450 contains data on typical custom-designed installations; describes

(*Continued on page 214*)

"PACKAGED" FANS

Clarage V-belt Ready Units answer economically your smaller air handling requirements

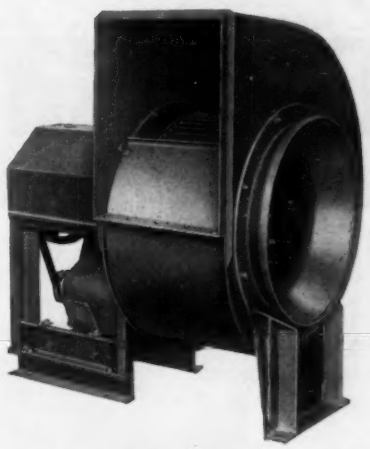
complete Ready to run, with fan, motor, and drive in one compact, easily installed assembly. 18 sizes, wheel diameters 9¾ to 32½", capacities to 12,000 cfm. Direct connected units also available.

adaptable Quickly adjustable in the field for various directions of air discharge. Slow speed, forward curved blade wheels or medium speed, backwardly inclined blade wheels available. Special units for handling corrosive gases and other special assignments can be provided.

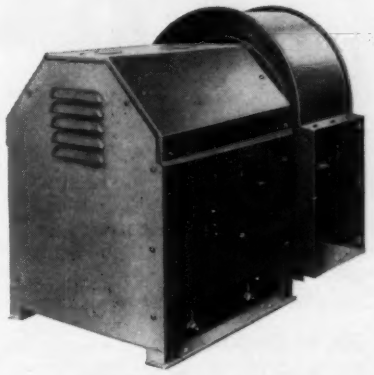
rugged Typical Clarage heavy-duty construction throughout. All working parts readily accessible, yet entire drive (except on largest sizes) is within frame of unit — an important distinguishing feature!

quiet When properly selected and applied, Clarage Ready Units meet the most exacting requirements in respect to quietness of operation.

capable Within their performance range, these units are unsurpassed for maximum air delivery at low power cost. You can select them with confidence for ventilation, exhausting, and other low pressure applications.



View of a standard Ready Unit as built in the medium-size range. Note how operating parts are shielded.



Ready Unit equipped with drive guard (at the end) and outdoor covers (on the sides) which provide complete weather protection.

For 28 pages of complete information on Clarage Ready Units, request Catalog 515.

CLARAGE FAN CO., Kalamazoo, Mich.

You can Rely on **CLARAGE** ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

BIN STUCK LATELY?

There are two ways to handle a stuck bin. You can bang it loose with a sledge hammer and damage your equipment; or you can install Cleveland Vibrators and put an end to your problem. The first way is slow and costly. But the second way is efficient, fast, and inexpensive.

How about you! Are your schedules suffering from stuck bins? The low cost of Cleveland Vibrators will surprise you, and the results will definitely please you. Why not get the whole story with a two-cent post card.

Air or Electric

Portable or Permanent

Silent or Standard

2824 Clinton Ave. · Cleveland 13, O.

More FREE LITERATURE

Begins on page 163

"packaged" system in capacities to 50 gpm. Dravo Corp, Industrial Dept, 5th and Liberty Aves, Pittsburgh 22, Pa.

28 **Heat exchangers** for process industries. Bulletin M-306 contains tables of effective surface area available in various units, overall dimensions, thermal design data with tables of film coefficients, pressure drops, fouling factors and tube characteristics necessary to solve basic heat-transfer equations. The Lummus Co. Heat Exchanger Div, 385 Madison Ave, New York 17, N. Y.

29 **Mechanical-drive turbines** operating at speeds of 10,000 rpm and above are described in 28-p bulletin GEA-6232. Construction and design features of turbine drives for centrifugal compressors and blowers are covered in detail. General Electric Co, Schenectady 5, N. Y.

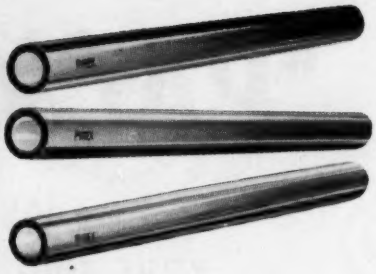
30 **Neoprene belting** to meet light-duty horizontal or inclined conveying, elevating and power transmission operations is described in 4-p bulletin 561. General Rubber Corp, Tenafly, N. J.

A contract has been awarded to Kaiser Engineers Division of Henry J Kaiser Co by the St Joseph Lead Company for the design, procurement and construction of a steam power plant at Josephtown, Pa. To cost approximately $16 million, the plant will have a capacity of 100,000 kw with provisions for expansion.

In an expansion move, The Okonite Company has purchased the 160-acre Studebaker-Packard plant at New Brunswick, N. J. Operations at the plant will be confined to manufacturing functions only. The company produces electrical wire, cable and splicing materials.

John P H Perry has been elected a consultant to the engineering firm Seelye Stevenson Value & Knecht, New York City.

"OK, so you were right. It wouldn't hold 500 pounds."



1 (for the gauge)

2 (for the shelf)

3 (for that emergency extra)

Don't be caught in a gauge glass shutdown.

Order 2 spares for every gauge glass you have. Then you have a ready replacement for routine use. The spare *spare* you use to hurry back into production should a glass go accidentally.

Protect yourself from replacement delay. Look ahead and avoid emergency.

Remember: "ONE FOR THE GAUGE AND TWO FOR THE SHELF." And always specify hard-to-break CORNING®, PYREX® and MACBETH® gauge glasses. It's the economical way.

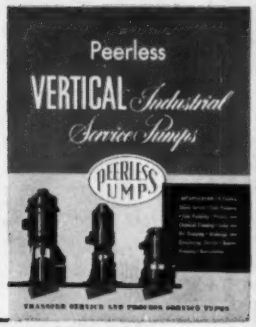
CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

Application	Recommended Product
Normal Conditions (Up to 100 p.s.i.)	CORNING brand standard gauge glasses
Higher temperatures	PYREX brand high-pressure gauge glasses
Higher pressures	PYREX brand heavy-wall gauge glasses
Extra visibility	PYREX brand red-line gauge glasses
Heavy-duty service	MACBETH brand flat gauge glasses
Viewing inside furnaces, reactors, pressure vessels, etc.	PYREX brand sight glasses
Lubrication inspection	PYREX brand lubricator glasses
Visible discharge devices	PYREX brand oil cup glasses

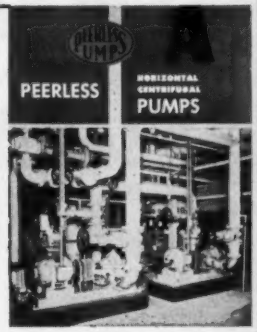
CORNING GLASS WORKS
Corning, New York

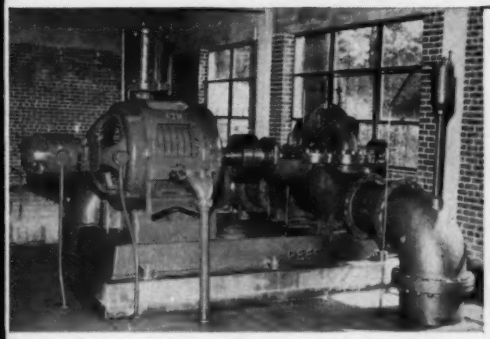
Corning means research in Glass

look AT THE PUMPING PROBLEM *two ways*



HoRizontal





VERTICAL

PEERLESS PUMP DESIGNS PROVIDE THE RIGHT TYPE FOR DOING THE JOB BETTER

You pick the design; Peerless will supply the pump. From one of the broadest range of pump capacities, heads, horsepowers, you can choose a Peerless horizontal or a Peerless vertical pump for almost every liquid transfer job, involving either water or process liquids.

In the picture at the top above, a concentrated solution of sulphuric acid and aluminum sulfate is being pumped by Peerless vertical industrial service pumps. To find out all about them request Peerless Bulletin No. B-505.

The Peerless horizontal type A pump shown just above, is one of three that supplies plant water for a textile mill. To find out all about them request Peerless Bulletin B-1300 and B-1350.

Use the coupon below to find how these Peerless designs can meet all your pumping needs with economy, efficiency and dependability.

PEERLESS PUMPS

fmc

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
Factories: Los Angeles 31, Calif., and Indianapolis 8, Ind.
Offices: New York; Atlanta; Chicago; St. Louis; Indianapolis, Ind.; Phoenix; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque, New Mexico.
Distributors in Principal Cities. Consult your Telephone Directory.

PEERLESS PUMP DIVISION
Food Machinery and Chemical Corporation
301 West Avenue 26, Los Angeles 31, California

Please send bulletins checked below:

- ☐ PEERLESS INDUSTRIAL SERVICE PUMPS (B-505)
- ☐ PEERLESS TYPE A HORIZONTAL PUMPS (B-1300)
- ☐ AND TYPE AS (B-1350)

NAME_____

COMPANY_____

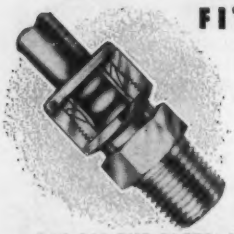
ADDRESS_____

CITY_____ STATE_____

POW

Don't lose your head, Use your head!

We think it is smarter to play safe. Wear safety helmets and use Swagelok® FITTINGS



GET ALL THE FACTS: Write for the Swagelok catalog. Address Dept. EB

CRAWFORD FITTING CO.
884 EAST 140th STREET
CLEVELAND 10, OHIO

More TECHNICAL BRIEFS

Begins on page 150

problem, summarize work done by the author's company, and emphasize progress being made in use of chemical treatment in specific cases. *APC paper; no number.*

Flyash and slag materials of value. *By R B Freston, Commonwealth Edison Co.*

With the advent of modern coal-firing methods, two solid byproducts of combustion came into being—finely divided flyash and a hard, glassy, black slag. Molten slag that dripped continuously from a wet-bottom furnace had to be accumulated and disposed of. Flyash could be allowed to escape with stack gases—but this was undesirable in urban areas.

There were no established markets for flyash and slag. Disposal as waste products was costly. A search for uses for these products was a natural result. Impetus has been added in the last decade by extensive capacity additions. A number of typical uses of these waste products are discussed. *APC paper; no number.*

Wood refuse spreader stoker firing of two steam generators. *By R W Martin Jr, Eugene Water & Electric Board, Eugene, Ore.*

Operation by this generating station shows that, with multiple fuels, traveling-grate spreader-stoker firing is more flexible than the Dutch oven. The stoker is faster in its response to load changes and is better adapted to proper application of automatic combustion control. Maintenance cost of the stoker-fired boiler is comparable to the Dutch-oven boiler with equivalent waterwall surface. Its availability, if different, is slightly better. Operators prefer the stoker. *ASME paper No. 56-S-21.*

Boilers

Supercharged boiler design, development and application. *By E L Daman and R Z Zoschak, Foster Wheeler Corp.*

Much interest has been expressed in various combined gas-turbine steam-turbine supercharged boiler cycles. A supercharged boiler is one operated in conjunction with a gas turbine in such a manner that combustion air for the boiler comes from a compressor driven by the gas turbine that in turn, is driven by expansion of the combustion gases leaving the boiler.

Advantages include a 5 to 9% improvement in plant heat rate, greatly

Directions for ordering papers on page 220

Coming!

MID-SEPTEMBER

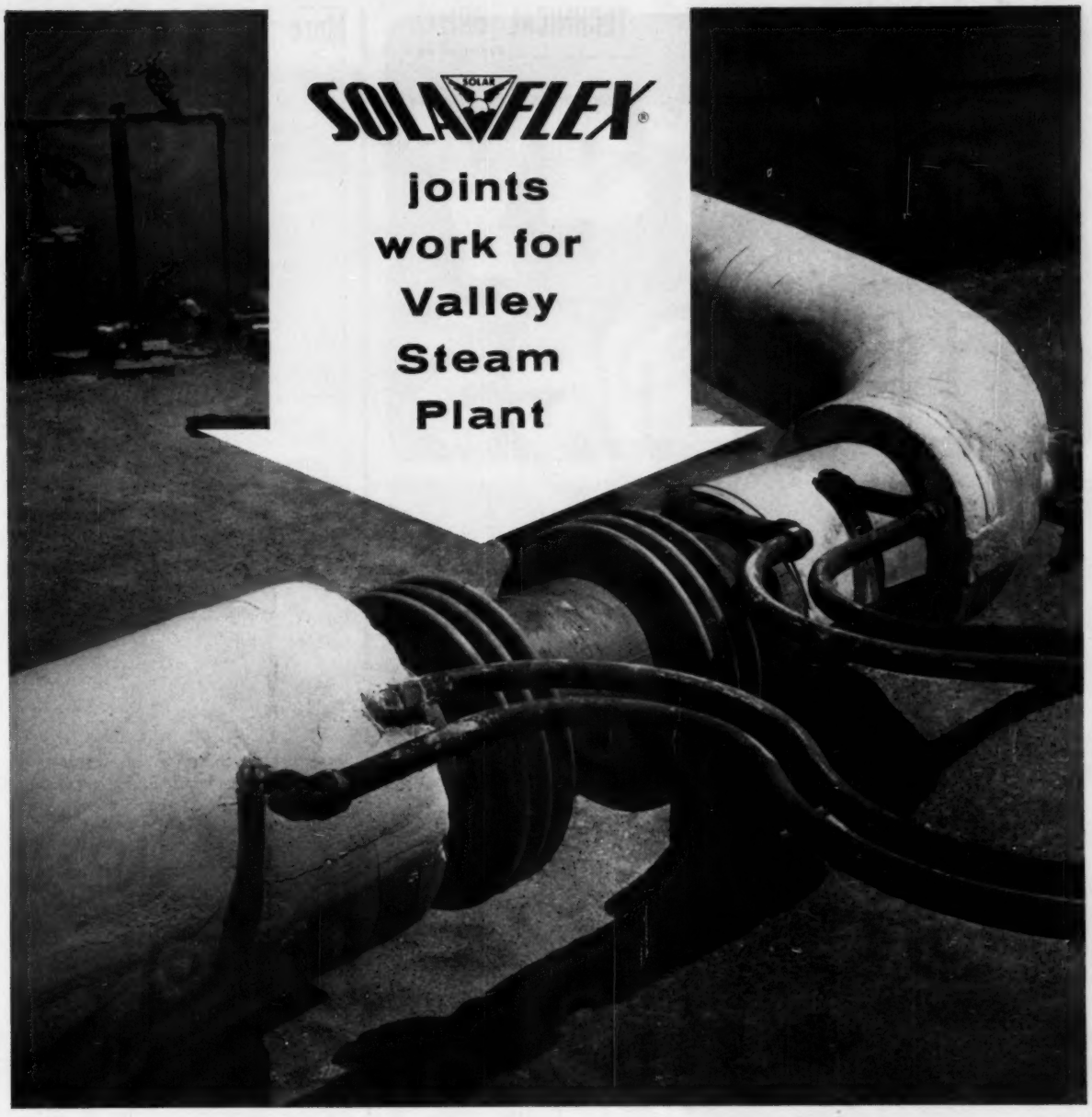
•

Power's MODERN PLANT YEARBOOK

•

- modernization data
- 5 useful features
- 'year round reference

"AN EXTRA SERVICE TO ALL SUBSCRIBERS"



SOLA-FLEX®

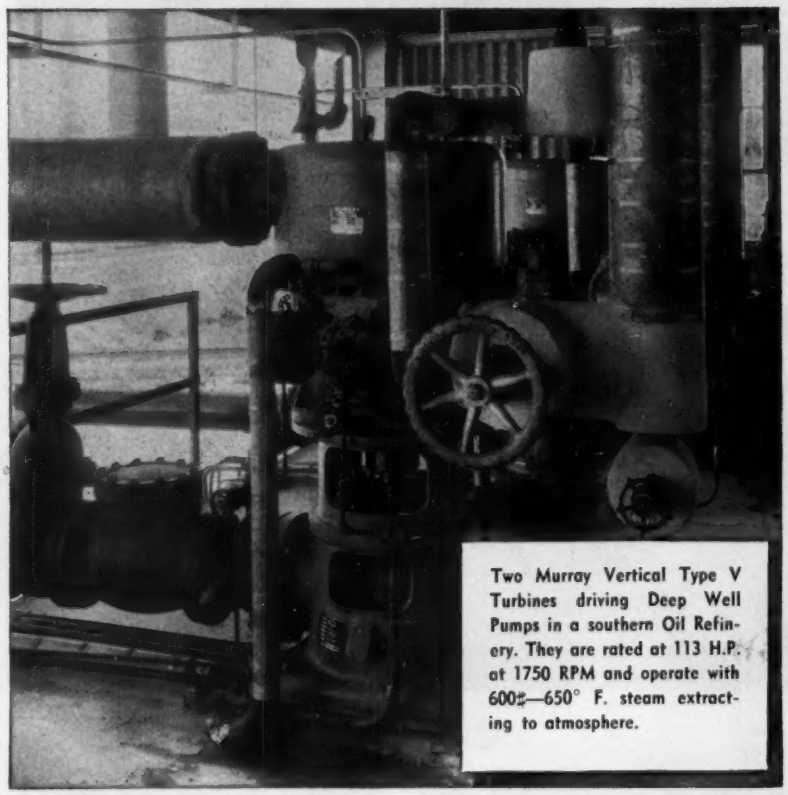
joints work for Valley Steam Plant

STEAM-TRACED tank lines move constantly with temperature variations. At the Los Angeles Department of Water and Power's Valley Steam Plant the Sola-Flex double-end expansion joint above is designed for 2 in. of axial and ¾ in. lateral movement. Similar joints can also take 1 in. axial and 2 in. lateral movement. Sola-Flex coded joints will solve your piping problems wherever you have temperature or pressure changes. Send for a Sola-Flex catalog today. Write Dept. C-39, Solar Aircraft Company, San Diego 12, California.

SOLAR
AIRCRAFT COMPANY
SAN DIEGO DES MOINES

DESIGNERS, DEVELOPERS AND MANUFACTURERS • GAS TURBINES • AIRCRAFT AND MISSILE COMPONENTS • BELLOWS • CONTROLS • COATINGS • METAL ALLOY PRODUCTS

Murray Turbines



Two Murray Vertical Type V Turbines driving Deep Well Pumps in a southern Oil Refinery. They are rated at 113 H.P. at 1750 RPM and operate with 600#—650° F. steam extracting to atmosphere.

• Murray Vertical V turbines, both geared and direct-connected, are being used more and more for driving vertical pumps of all types. The Murray Vertical V turbine is designed from top to bottom as a vertical turbine, not just a horizontal turbine, "upended." The Murray Vertical is especially constructed and arranged for vertical mounting.

Murray vertical turbines can be furnished for steam pressures up to 600# 750° F. TT. and back pressures as high as 100# and can carry most normal thrust loads imposed by vertical pumps.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

More TECHNICAL BRIEFS

Begins on page 150

reduced boiler size and weight, improved load response and reduced starting time, savings in piping.

Supercharged boilers are destined to be important in future steam generation. Although designs discussed in this paper are available for areas with favorable fuel conditions, much work remains to be done to make these units suitable for broad application. *APC paper; no number.*

Full-scale tests and operational performance of steam washers. *By L G Friedle, The Dow Chemical Co.*

Problem of turbine-blade fouling, existing prior to use of steam washing, is discussed in this paper. Results achieved are evaluated.

Sizable savings resulted from increased power production of main turbines and decreased steam consumption of auxiliaries. Many intangible savings, like decreased maintenance of turbines and other equipment, also exist. *APC paper; no number.*

Pumps

Design and operation of freeze-seal valve and pumps. *By R Cygan and A M Stelle, North American Aviation, Inc.*

Frozen seals have been developed for sealing stationary- and rotating-shaft penetrations, affording a simple means of adapting commercial equipment to high-temperature liquid metal systems. Several designs for sealing sodium at temperatures up to 1200 F have been satisfactorily tested. Under different operating conditions cooling loads, torque and pressure differentials across the seals were measured. Location of the frozen seal away from high temperature allows for a design of an annulus of frozen metal around the shaft while cooling loads are kept small. *NESC paper No. 82.*

Critical considerations on cavitation limits of centrifugal and axial-flow pumps. *By Dr G F Wislicenus, The Pennsylvania State University. ASME paper No. 55-A-144.*

Thermodynamic aspects of cavitation in centrifugal pumps. *By H A Stahl and A J Stepanoff, Ingersoll Rand Co. ASME paper No. 55-A-136.*

Turbulence and boundary layer effects on cavitation inception from gas nuclei. *By J W Daily, Massachusetts Institute of Technology and V E John-*

Directions for ordering papers on page 220

NO HEAT LOSSES HERE! At TVA Widows Creek Power Plant, the vertical main steam line at left is insulated with 3" of K&M Hy-Temp and 2" of "Featherweight" 85% Magnesia. Distribution manifold and branch mains are insulated with 2" 85% Magnesia. Insulation contractor, Armstrong Cork Company.

K&M HIGH-PRESSURE INSULATIONS MEAN IMPORTANT HEAT SAVINGS

Piping heat-losses can be high if insulations are not designed for specific applications. K&M High-Pressure Insulations are so designed—to cut waste and save you money. There is a K&M High-Pressure Insulation for your every requirement.

For efficiency to 1900° F. there's K&M Hy-Temp Combination Insulation. It's made of diatomaceous silica, heat-resistant fillers and asbestos fiber, overlaid with K&M "Featherweight"® 85% Magnesia. Joints are staggered for the utmost in heating efficiency.

For efficiency to 600° F. there's K&M "Featherweight" 85% Magnesia. Made of 85% basic carbonate of magnesia and asbestos fiber, "Featherweight" withstands moisture, vibration and frequent temperature changes.

Contact your K&M distributor, who is an experienced applicator, or write directly to us, for further information.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

In Canada: Atlas Asbestos Company, Limited; Montreal, Toronto, Winnipeg, Edmonton, Vancouver

tubes

all sizes and gauges always on hand

ACCURATELY FABRICATED

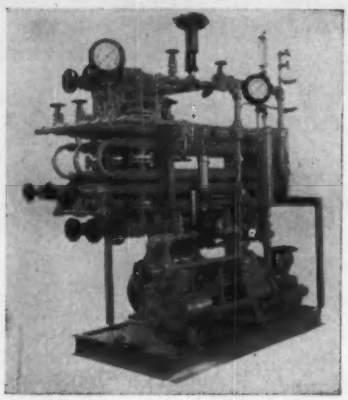
BOILER TUBE CO OF AMERICA

McKEES ROCKS, PA.
Pittsburgh District

PITTSBURGH • CHICAGO • FRED S. RENAULD & CO., LOS ANGELES

LOCKETT FUEL OIL PUMPING AND HEATING SETS

Custom Built



A composite Pump and Heater Set, consisting of one Worthington Steam-Driven Duplex Pump and one Electric-Driven Rotary Pump, with Griscom-Russell Twin G-Fin Heaters mounted above the pumps. Complete with pressure and temperature controls. Fabricated to Consulting Engineer's Specifications. Capacity: 10 GPM of bunker C fuel oil against 175 PSI. Steam pressure 250 PSI.

For more than a half-century, Lockett has been supplying standard and custom-built Fuel Oil Pumping and Heating Sets, for mechanical and steam atomizing oil burners. Various types of Pumps are available: Turbine or Motor-Driven Rotary Pumps, Electric-Driven Rotary Pumps, and Duplex Steam Pumps, in any combination. Units can be furnished for any capacity or pressure desired; complete with Strainers, Pressure and Temperature Controls, and Instruments. Each pump is suitable for the full rated capacity of the Unit; one pump and one heater are spares. Engineered to your requirements. Completely assembled and shop-tested. Inquiries are invited. *Descriptive bulletins sent on request.*

A. M. LOCKETT & COMPANY, LTD.
Contracting Mechanical Engineers
NEW ORLEANS • HOUSTON • DALLAS

More TECHNICAL BRIEFS

Begins on page 150

son Jr, National Advisory Committee for Aeronautics. ASME paper No. 55-A-142.

Some aspects of high-suction specific-speed pump inducers. *By C C Ross and G Banerian, Aerojet-General Corp. ASME paper No. 55-A-124.*

A method for analyzing the stresses in centrifugal impellers. *By J W Glessner, Elliott Company. ASME paper No. 54-A-167.*

The design of axial-flow pumps. *By R D Bowerman, California Institute of Technology. ASME paper No. 55-A-127*

References

Nuclear engineering literature. *By Raymond L Murray, North Carolina State College.*

Attention is called to the large variety of sources of information on the applications of nuclear energy and the difficulty of selection of up-to-date references. Bibliographies of existing reports, papers, and books are cited and reference is made to the current abstracting service by the Atomic Energy Commission. A list of key references, is presented. *NESC paper No. 239.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

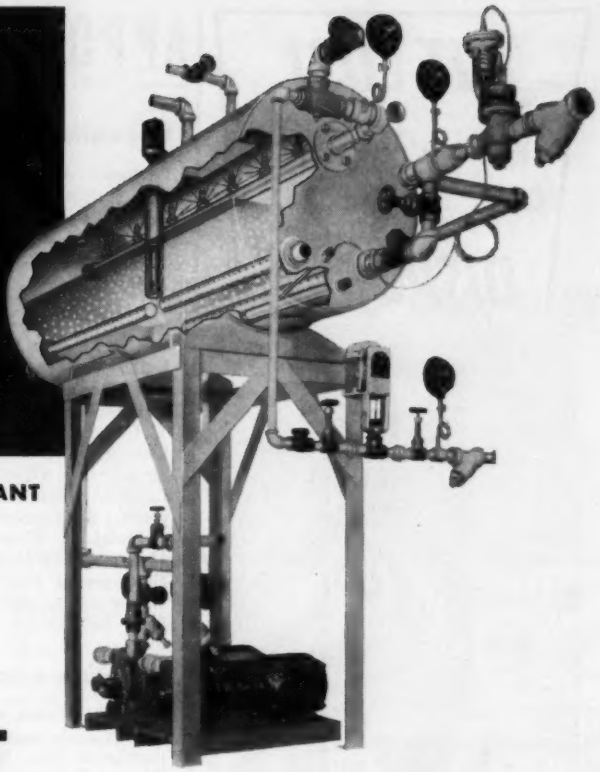
American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39 St, New York 18, New York.

American Power Conference, 18th annual meeting. Identified by initials APC and obtainable through purchase from Director, APC, Illinois Institute of Technology, Chicago 16, Ill.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

Papers identified by initials NESC, Nuclear Engineering and Science Congress, are obtainable at 30c each from the American Institute of Chemical Engineers, 25 W 45th St, New York 36, N.Y.

SCHAUB "03" DEAERATOR



FOR THE SMALL TO MEDIUM STEAM PLANT

- **Combats "Return Line" Corrosion**
- **Guarantees Oxygen Removal to .03 cc/liter**
- **Simpler in Principle and Operation**
- **Pays for Itself in Savings**

HOW TO CUT CORROSION COSTS

without Breaking Your Budget

If your steam needs are in the 3,000 to 30,000 lbs./hr. range the Schaub .03 Deaerator was designed with you in mind.

It is in plants of this size range — often operating at low pressure — that "return line" corrosion is most likely to be a continual costly maintenance item. A Schaub .03 Deaerator effectively combats this and at very low cost. It is equally applicable to high pressure installations.

The *big* difference between the Schaub .03 and other low-cost deaerators is that it operates *fully vented* at atmospheric pressure for better gas removal. Yet wasteful steam vapor loss is prevented regardless of load variations by the simple, but effective Schaub spray-contact vent condensing method. Other exclusive features that boost efficiency are pin-point temperature control and "live action" heating of storage water. This provides more forceful "break-away" of air molecules.

With fully vented design, no premium-cost pressure construction is needed and maintenance and operating costs are reduced to a minimum. Rust-proof Chromosoid lining adds years of trouble-free life.

NOTE: For boiler capacities up to 100,000 lbs./hr. and .005 cc/liter oxygen removal, write for Bulletin *575*, describing the unique Schaub Zero-Oxygen Deaerator.

SEND FOR BULLETIN 1300

The full facts on the "hows", "whys" and basic differences in the Schaub .03 method. Filled with facts for the operating or consulting engineer responsible for boiler feedwater deaeration.

FRED H. SCHAUB ENGINEERING CO.

2105 South Marshall Boulevard • Chicago 23, Illinois

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Blvd., Chicago 23, Illinois

Please send me, without cost or obligation, my personal copy of your new Bulletin 1300 on Boiler Feedwater Deaeration.

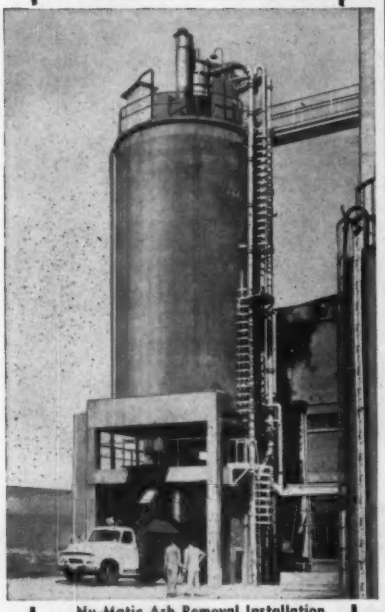
Name_____

Company_____

Address_____

City_____ Zone_____ State_____

CUT COST
of
ASH
DISPOSAL



Nu-Matic Ash Removal Installation

HYDRO-ASH
HYDRAULIC OR PNEUMATIC
ASH CONVEYOR SYSTEMS
for any size plant

Each system individually designed for continuous or intermittent type operation, to insure

• Low Initial Cost • Low Steam Consumption • Low Maintenance • High Capacity

WRITE TODAY FOR FULL INFORMATION

HYDRO-ASH CORPORATION
260 FORTY-SECOND STREET,
PITTSBURGH 1, PA.

APPOINTMENTS

Corporation executive changes

National Aluminate Corp: J A Holmes, president, succeeding H A Kern who continues as chairman of the board. **Webster Electric Co:** David J Munroe, president. **Tube Turns,** a division of National Cylinder Gas Co: John G Seiler, president, succeeding George O Boomer, retired.

The Electric Storage Battery Co: E J Dwyer, vice-president. **The Trane Co:** Allen C Menke, vice-president. **Westinghouse Electric Corp:** Frank W Godsey Jr, A M Kennedy Jr, F M Sloan and W Waits Smith, vice-presidents. **The Okonite Co:** Rhea P Lapsley, vice-president, research and product development.

Metal & Thermit Corp: H D McLeese, vice-president. **The Rust Engineering Co:** George I Seybold, vice-president. **McDonnell & Miller, Inc:** Bill Gleeson, vice-president.

Operations executive changes

General Electric Co: Frank E Stehlik, general manager of low-voltage switchgear dept. **W S Rockwell Co:** Richard E Love, manager of valve division. **E F Houghton & Co:** Robert K Smith, manager of research. **Consolidated Diesel Electric Corp:** Louis B Haberman, general manager of test equipment division.

Engineer changes

W-K-M Manufacturing Co, Inc: H Ben Young, director of engineering. **Fairbanks, Morse & Co:** J F Weiffenbach, director of engineering. **General Electric Co,** silicone products dept: Stuart D Brewer, manager, resin product engineering; Frederick M Lewis, manager, advance development; Abbott Pozefsky, manager, analytical and control methods unit; William F Gilliam, specialist, technical information exchange. **Henry Pratt Co:** Abdon J Brazaitis, head of application engineering dept. **Elliott Co,** Crocker-Wheeler motor division: Charles R Steen, manager of engineering.

Worthington Corp, Harrison division: E C Schmachtenberg, assistant to manager of engineering; Hunt Davis, chief engineer, compressors; C A Macaluso, assistant chief engineer, compressors; W F Donovan, assistant manager, research and development. **Penn-Union Electric Corp:** Morris Brenner, chief engineer.

Consulting engineers

Formation of **O'Mara and Flodin, Inc,** 1111 Wilshire Blvd, Los Angeles 17, Calif., specializing in dust and fume control, drying and air separation. Formation of **Hemeon Associates,** Loeffler Bldg, 121 Meyran Ave, Pittsburgh, Pa.; headed by Wesley C

ERNST
Boiler Accessories

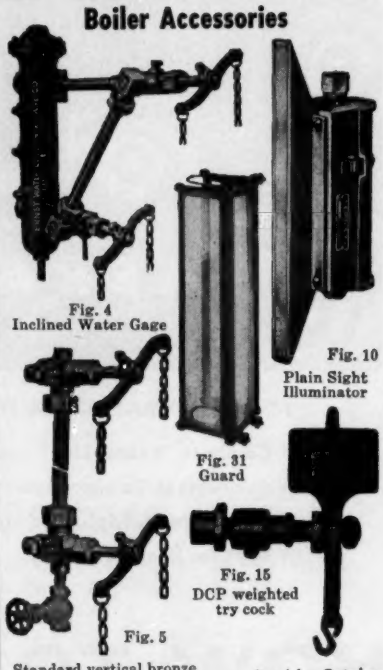


Fig. 4 Inclined Water Gage
Fig. 10 Plain Sight Illuminator
Fig. 31 Guard
Fig. 15 DCP weighted try cock
Fig. 5 Standard vertical bronze water gage, 350 pound

Send for Catalog

ERNST WATER COLUMN & GAGE CO.
Livingston, N. J.

IMPORTANT SAFETY for your plant!

Slip-resistant

Tri-Lok and Tri-Forged
Serrated grating and stair treads

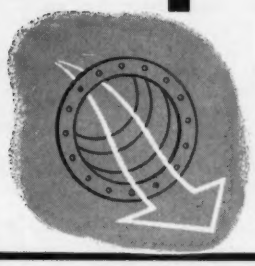
Don't take chances in those plant areas where grease, oil or other conditions make floors slippery and dangerous! Play it safe with the non-skid, notched surface of *Tri-Lok* or *Tri-Forged* serrated grating and stair treads. Here is a walking surface that is hazard-proof and the ultimate in safety. To be sure you have complete information on these and other *Tri-Lok* and *Tri-Forged* products, write today.

For free catalog write Department D-2106

DRAVO CORPORATION
Pittsburgh 22, Penna.
National Distributors

SMS ROTOVALVES

—STILL THE BEST VALVE YOU CAN BUY



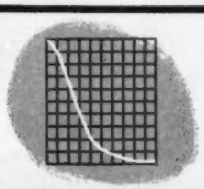
Only Rotovalves give you all these features:

LEAST PRESSURE LOSS

Full line opening means less head loss, lower pumping costs.

EASIEST TO OPERATE

Hydraulic imbalance and mechanical design mean 1 man can close as fast as required. Less power needed in mechanical or electrical operation.

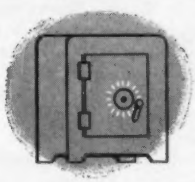


GREATEST INITIAL SHUT-OFF

Rotovalve 55% closed at 25% stroke, and 92% closed at 50% stroke. In comparison, gate valves only 18% closed at 25% stroke and 43% closed at 50% stroke.

MOST CONTROLLED CLOSING TIME

Closing as quickly as one second or as slow as needed. Fast initial closing limits reversal of flow.



MOST POSITIVE CLOSING

Drop-tight, positive closing. Self-purging, monel-to-monel seating. Pressure-tight bolted head, stuffing box, and machined and lapped seats.

In addition to all these features typical of SMS engineering, Rotovalves have a flexibility that makes them suitable for any type of operation, any method of control, or any sort of location.

For detailed information about SMS Rotovalves, Ball or Butterfly Valves, see our local representative or write to the S. Morgan Smith Company, York, Pa.

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

HYDRAULIC TURBINES
PUMPS
GATES & HOISTS
TRASH RAKES
ACCESSORIES

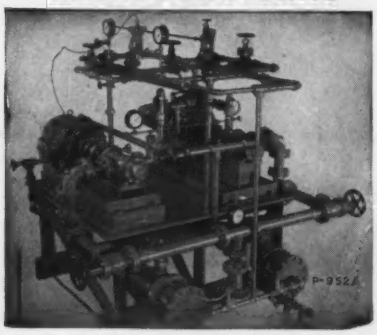
HYDRODYNAMICS

ROTOVALVES
BALL VALVES
BUTTERFLY VALVES
FREE DISCHARGE VALVES
CONTROLLABLE-PITCH SHIP PROPELLERS

NATIONAL AIROIL

SERVING INDUSTRY'S COMBUSTION REQUIREMENTS FOR 43 YEARS

NATIONAL AIROIL FUEL OIL PUMPING and HEATING UNITS



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

Complete range of sizes and models in both medium and high pressure types . . . *more compact than ever!* Write for Bulletin 40.

NATIONAL AIROIL COMBUSTION ACCESSORIES

AIR CONTROL DOOR and FRAME

FUEL-OIL SUCTION STRAINER

WIDE VIEW PEEPHOLE

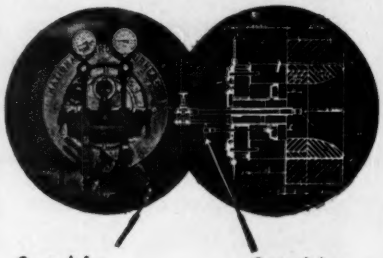
IGNITION PORT

FURNACE RELIEF and ACCESS DOOR

FUEL-OIL HEATER

These and other "accessory items" for every industrial liquid fuel-gas installation. Ask for Brochure No. 10.

NATIONAL AIROIL UNIVERSAL REGISTERS with TYPE "SA" OIL BURNERS



Control for Air Vane

Control for Refractory Faced Disk

BETTER PERFORMANCE with NATIONAL AIROIL Universal Registers because they have a DUAL FEATURE for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disc control. Both adjustments can be made while the burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil. Universal Registers with burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

1230 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

More APPOINTMENTS

Begins on page 222

L Hemeon, and specializing in all aspects of air pollution. Frank L Phillips joins the Peter Elbal organization—firm's name will be **Phillips & Elbal,** with offices at 45 W 45th St, New York 36, N. Y. Howard R Wright joins firm of A L Swanson to form **Swanson, Wright & Co Ltd,** 2210 W 12th Ave, Vancouver 9, B.C. **R R Popham Engineer** has moved to 2 Park Ave, New York 16, N. Y., this also being new address of **Laramore, Douglass & Popham, Inc,** Chicago associate firm. **William E Hill & Co, Inc,** has moved to 640 5th Ave, New York 19, N. Y.

New sales managers

Elliott Co: Philip Scarola, Crocker-Wheeler motor division. **Baldwin-Hill Co:** J L Mohun, industrial insulation division. **Henry Pratt Co:** Henry C Schwenk, butterfly valve division.

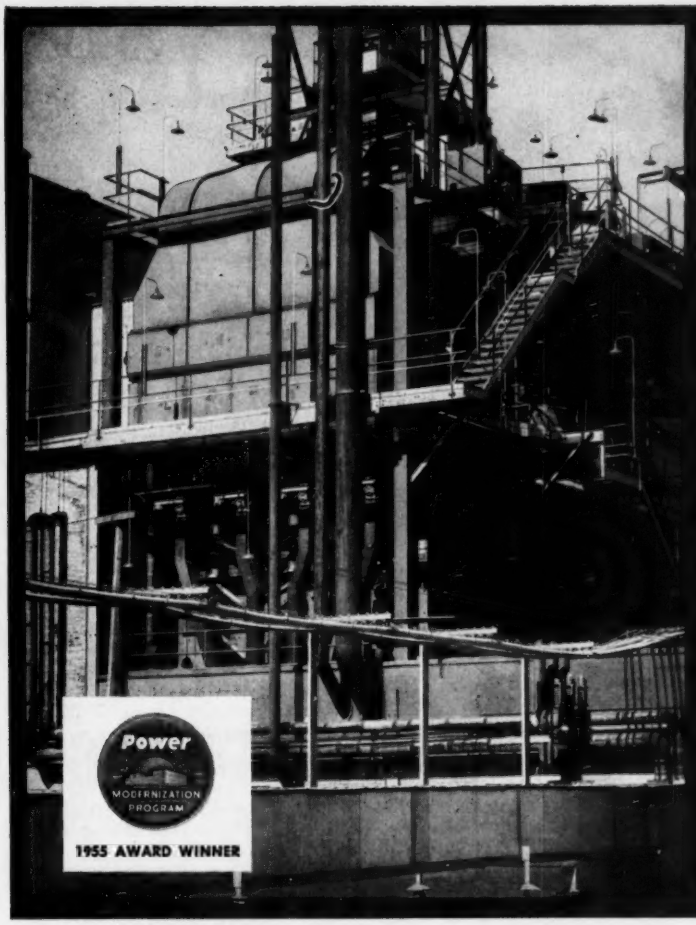
The Mercoid Corp: Willis E Jones. **H K Porter Co, Inc:** Carl J Siebert, W-S Fittings division. **SKF Industries, Inc:** James H Sutherland, Midwestern region. **McDonnell & Miller, Inc:** Eugene Mitchell and James W Platt, regional sales managers; Fred Rohe, district manager for Indiana and western Kentucky. **Worthington Corp:** Charles D Cummins, Seattle office. **Electric Controller & Mfg Co:** Howard Scheidle, Philadelphia district. **Allis-Chalmers Manufacturing Co:** A P Bowman, Rockford, Ill. office. **U.S. Rubber Co:** Henry Davis Jr, Pittsburgh district; Douglas M Smith, Baltimore district.

New district offices

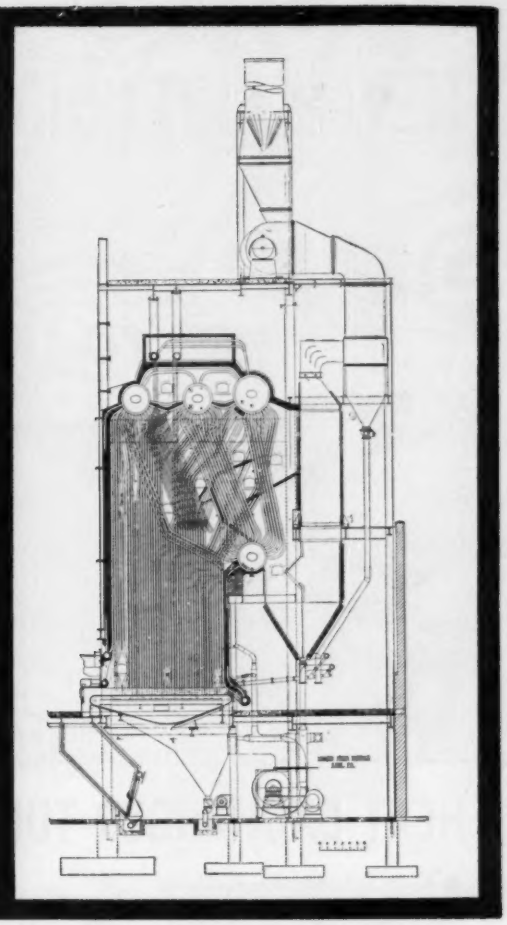
M W Kellogg Co: in Russ Bldg, San Francisco, Calif., William R Dunn, manager. **The Trane Co:** at 2440 Kenwood Manor, Sioux Falls, S. D., Richard E Jameson, sales representative in charge. **L-O-F Glass Fibers Co,** Corrulux division; in Merchandise Mart, 2001 Grand, Kansas City, Mo., Walter F Comstock, manager. **Dresser Industries, Inc:** at 401-08 The Folger Bldg, Washington, D.C., Urban Niblo, director. **Mine Safety Appliances Co:** at 2500 12th Ave, N, Birmingham 4, Ala.

Institute elections

Air-Conditioning and Refrigeration Institute: Matthew M Lawler, president; Lud Emde, vice-president; C E Buchholzer, treasurer. **American Welding Society:** J J Chyle, president; Clarence P Sander, 1st vice-president; G O Hoglund, 2nd vice-president. **Steel Founders' Society of America:** Howard F Park Jr, president; George W Myers, vice-president; R G Parks, treasurer; F Kermit Donaldson, executive vice-president; Charles W Briggs, technical and research director; George K Dreher, secretary.



John Strange Paper Co., Menasha, Wisconsin



Longitudinal Section of Union Boiler

165,000 lbs/hr Union Boiler plays key role as John Strange wins power modernization award

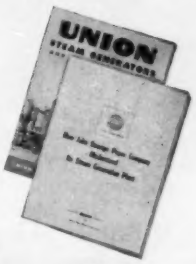
Named 1955 winner of POWER Magazine's Modernization Award, John Strange Paper Company is ranked with the leaders in its industry on the basis of BTU's used per ton of paper produced.

In remodeling its power plant, John Strange followed the recommendations of Cummins and Barnard, Inc. A Union 4-drum boiler was installed to supply steam for both electrical power and processing.

With a steaming capacity of 165,000 lbs/hr at 725 psig and 825° F, this Union semi-outdoor boiler has played a key role in helping boost paper production 10% while saving 29% in fuel costs without increasing plant personnel.

From start to finish, the report "How John Strange Paper Company Modernized Its Steam Generation Plant" is an interesting example of planning power services around a process. It typifies the way in which Union Boilers perform in numerous industrial installations from coast to coast.

GET FULL DETAILS
Both a copy of this story, as it originally appeared in POWER, plus illustrated Catalog GB-153 showing several types of boilers built by Union, will be mailed on request. Write.

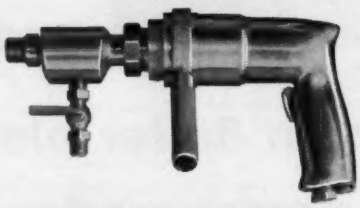


UNION

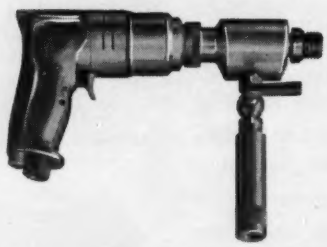
UNION IRON WORKS
ERIE, PENNSYLVANIA

HEAT EXCHANGER TUBE CLEANER

- New light-weight, handy-to-use machine enables you to zip through the small tube cleaning chore in a jiffy.
- Powerful air-driven motor with attached non-rotating, water feeding attachment, trigger-action for motor control, finger-action valve for water flow to cool drill and flush tubes.
- Built-in speed governor eliminates shaft-whip caused by the excessive speed when not loaded.
- Built-in oil reservoir insures far longer life and less need for maintenance.
- Choice of two sizes. For details, contact your local Elliott representative or write Elliott Company, Springfield, Ohio.



ELLIOTT 512400
Heat Exchanger Tube Cleaner
Weight: 6½ lb — Length: 13 in



ELLIOTT 512300
Heat Exchanger Tube Cleaner
Weight: 5 lb — Length: 10½ in

Y6-4a

ELLIOTT Company

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

REPORTS from the FIELD

Begins on page 148

Nuclear facilities plant

(*Continued from p* 148)

Literally scrubbing the air of particles of nuclear materials in the plant's main building is an elaborate circulation and filtration system. The fabrication area, for example, undergoes a dozen complete air changes hourly, with seven circulation units drawing in over 100,000 cu ft a minute.

Exhaust ports at key points in the circulation system are equipped with microscopically-fine filters that removes about 99.5 percent of airborne materials. In the critical experiment building and plant laboratories, filter monitoring devices sound alarms and shut down some operations automatically if significant amounts of radioactive gases appear.

300-ton gantry crane

(*Continued from p* 148)

be capable of lifting either a generator rotor or the runner of its 75,000-hp propeller-type turbine.

Encased on all four sides by aluminum sheathing and with vertical lift doors at each end, it will provide enclosed working space for maintenance crews.

The St. Lawrence gantry will be similar to the 265-ton unit shown in foreground of photo on page 148. This unit is one of two built by Dominion Bridge for power developments on the Peribonka River in Quebec.

ISA to hold annual conference and exhibit in New York

► The 11th Annual International Instrument-Automation Conference and Exhibit, sponsored by the Instrument Society of America, will be held in the New York Coliseum, September 17-21, 1956.

In addition to exhibits by leading instrument and automation firms, a well-integrated educational program consisting of clinics, workshops and technical sessions will be held. Demonstrations on how to operate and maintain the increasing number of new instruments will be given.

Large gas-turbine installation ups Canada's electrical output

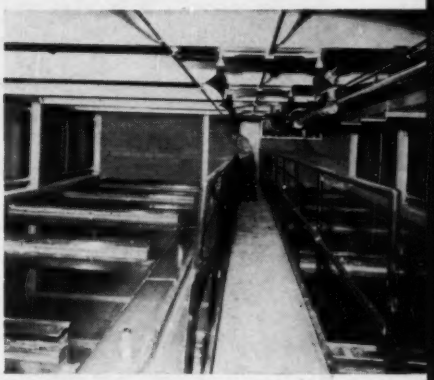
► One of the world's largest installations of gas turbines for generation of electric power will be placed in operation in Victoria, B.C. in 1957.

The British Columbia Power Commission has ordered four gas-turbine-generator units with a total electrical

NEW VERMILION STATION
near Danville, Illinois, was designed by Sargent & Lundy. 75,000-kw Unit 1 went on the line in May 1955. 100,000-kw Unit 2 goes in service October 1956.

Chemical Feeders: 1st step in treating all water for plant use is accurate dosages of lime and alum for treatment in Precipitator.

1800 gpm Precipitator clarifies and softens cold river water. Dealkalizes, too—eliminating need for degasifier in demineralization.



ILLINOIS POWER EXPANDS AGAIN!

Latest 175,000-kw station is protected by Permutit-conditioned water

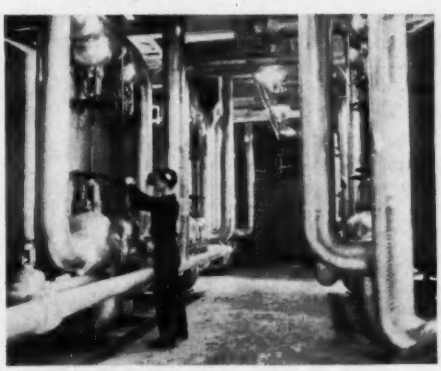
To meet rapidly growing needs, progressive Illinois Power Company has built two high-pressure stations within two years.

75,000-kw Hennepin Station went on the line in 1954. Its 1450 psig boiler requires *feedwater of the highest quality*. To produce this makeup, Permutit Demineralizers were installed.

When Illinois Power built the new Vermilion Station, Permutit water conditioning was installed again. To protect its turbine and boiler, all makeup is demineralized by the Permutit ion exchangers shown.

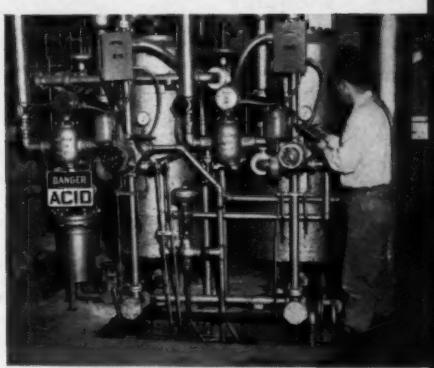
For Vermilion's big cooling-tower system, a different grade of water is most economical. The Permutit Precipitator and Filters shown produce it.

You can get this complete protection for your plant. We'll gladly help. Write outlining your problem. The Permutit Company, Dept. P-7, 330 West 42nd Street, New York 36, N. Y. Permutit Co. of Canada, Ltd., 207 Queen's Quay, Toronto 1, Ont.



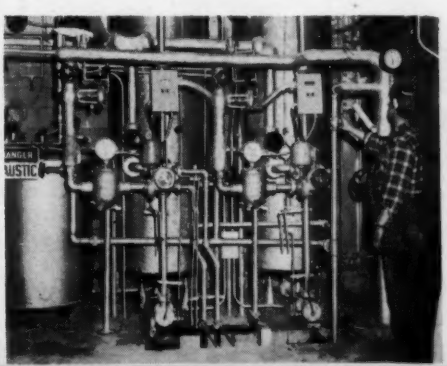
Pressure Filters further clarify Precipitator effluent . . . deliver finished water to protect Vermilion Station's 53,000 gpm cooling-tower system.

Anion Exchangers: Permutit S resin removes the few remaining minerals . . . protects Vermilion Station's turbine from troublesome silica deposits.

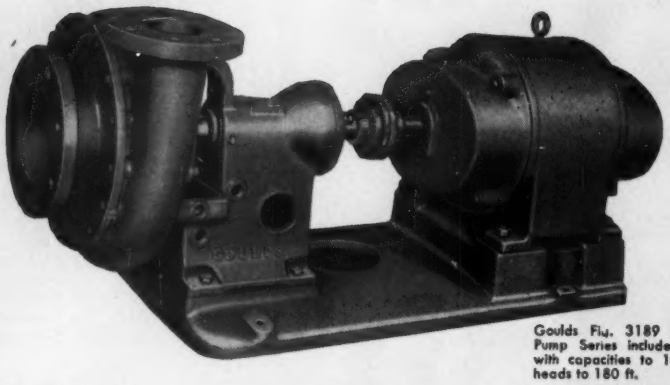


Cation Exchangers: Permutit Q resin removes metallic cations from Precipitator effluent to prevent boiler scale . . . allow high heat-transfer rates.

Control Cubicle operates demineralizers. Determines end-point, then sequences backwashing, regeneration, rinsing, return to service. Even prepares regenerant charges.



PERMUTIT®
WATER CONDITIONING
Equipment • Resins • Experience



Goulds Fig. 3189 Centrifugal Pump Series includes 10 sizes with capacities to 1080 GPM, heads to 180 ft.

interesting facts

...about a new series of Goulds Multi-Purpose Centrifugal Pumps

Newest in a line of heavy-duty centrifugal pumps reputed for their dependable, trouble-free operation, the Goulds Fig. 3189 Series offers you:

Versatility — You can use the Fig. 3189 single-stage, open impeller pumps for general water service, irrigation, circulation, slurries, transfer, factory wastes and for air conditioning. You can choose just the right pump for your need from 10 sizes with capacities ranging up to 1080 gallons per minute, with heads up to 180 feet at 1750 RPM.

Economy — The Fig. 3189 Series is made in the Goulds tradition—they're built to work hard and to last long. Their design accommodates wide interchangeability of parts, greatly reducing parts inventory requirements where many pumps are used.

Low Operating Cost — Modern hydraulic design provides high operating efficiency with relatively low power consumption. Impellers are statically and hydraulically balanced for smooth operation.

Operating Convenience — You can adapt the Fig. 3189 pump to various piping arrangements by swiveling the discharge nozzle to any one of three positions.

Maintenance Convenience — Wide openings in the support head give ready access to gland and stuffing box. Bearing housing is completely sealed to exclude moisture and dirt. *You can safely use the unit outdoors without fear of dirt harming the bearings and you can hose it down without fear of water damage.*

For specifications, performance curves and other interesting design details that contribute to long, economical service, send for illustrated Bulletin 720.4.

MEMBER

Goulds PUMPS INC. Seneca Falls New York

ATLANTA • BOSTON • CHICAGO • HOUSTON • NEW YORK
PHILADELPHIA • PITTSBURGH • TULSA

REPORTS from the FIELD

Begins on page 148

power capacity of more than 75,000 kw from General Electric Co's Gas Turbine Dept, Schenectady, N.Y. The units will be installed in a power station in the city of Alberni, located on the east side of Vancouver Island.

Order includes two 19,750-kw single-cycle, single-shaft units and two 18,000-kw regenerative-cycle, single-shaft turbines. They will have a 50 F inlet temperature at an altitude of 200 ft above sea level. Turbines will have a top speed of 910 mph and the air will travel through turbines' compressor at 314 mph.

Each unit will drive a 3600 rpm, 3-phase, 60-cycle, hydrogen-cooled generator that will produce 13,800 v of electric power at 60 cycles. Delivery of the first unit is expected to be made early in 1957.

Great Northern Paper Company contracts for new power plant

► A CONTRACT for design and construction of Great Northern Paper Co's proposed 31,250-kw power plant at Millinocket, Me. has been awarded to Stone & Webster Engineering Corp.

The plant will consist of two 15,625-kw turbine generators, one noncondensing and the other condensing, extracting and mixed pressure, supplied by three 300,000 lb/hr coal- or oil-fired boilers operated at 1250 psig, 855 F. Commercial operation of the plant is scheduled for October 1957.

Calendar of Events

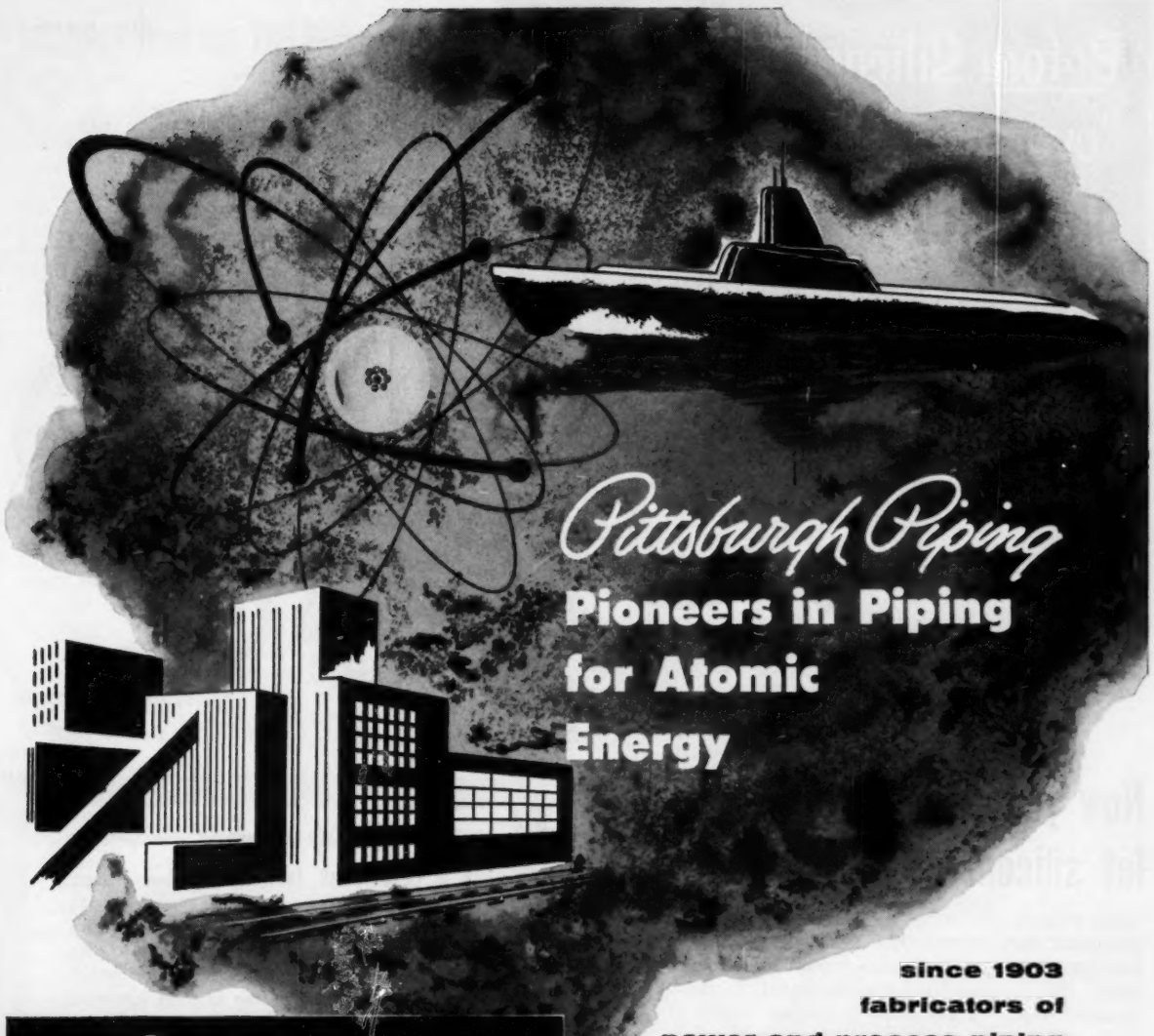
July 16-18—7th Diesel Power Plant Conference, Iowa State College. Details from Engineering Extension, Iowa State College, Ames, Iowa.

July 30-Aug. 3—American Association for the Advancement of Science, Gordon Research Conference on ion exchange. Kimball Union Academy, Meriden, N. H. Details from W George Parks, director, department of chemistry, University of Rhode Island, Kingston, R. I.

Aug 11-15—American Society of Mechanical Engineers, 1st National Conference on Applied Heat Transfer. Pennsylvania State University. Details from ASME, 29 W 39th St, New York 18, N. Y.

Sept 20-22—Institute of Power Engineers, Annual Convention. Royal Alexandra Hotel, Winnipeg, Manitoba, Canada. Details from IPE, 239 Linden Ave, East Kildman, Winnipeg 5, Manitoba, Canada.

Sept 24-25—Steel Founders' Society of America, Fall Meeting. The Green-

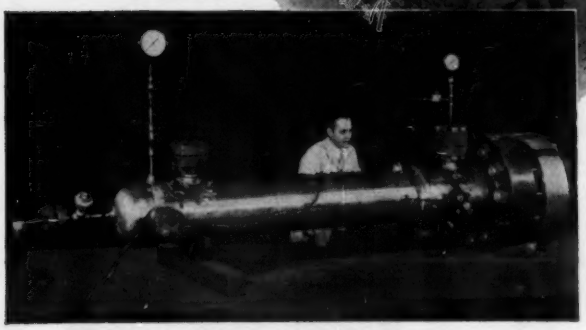


Pittsburgh Piping

Pioneers in Piping for Atomic Energy

since 1903
fabricators of
power and process piping
for these industries...

Electric Generating
Paper and Pulp
Chemical Processing
Basic Metals
Food
Textiles
Transportation
Manufacturing
Ordnance
Refining



P. P. & E. produced the first piping installations for marine and stationary nuclear power plants. Our facilities are complete—metallurgical research, laboratory service, engineering, shop fabrication, testing, and field erection. We have fabricated stainless steel piping for power and process industries since the middle 1920's.

Pittsburgh Piping

AND EQUIPMENT COMPANY

158 49th Street — Pittsburgh, Penna.

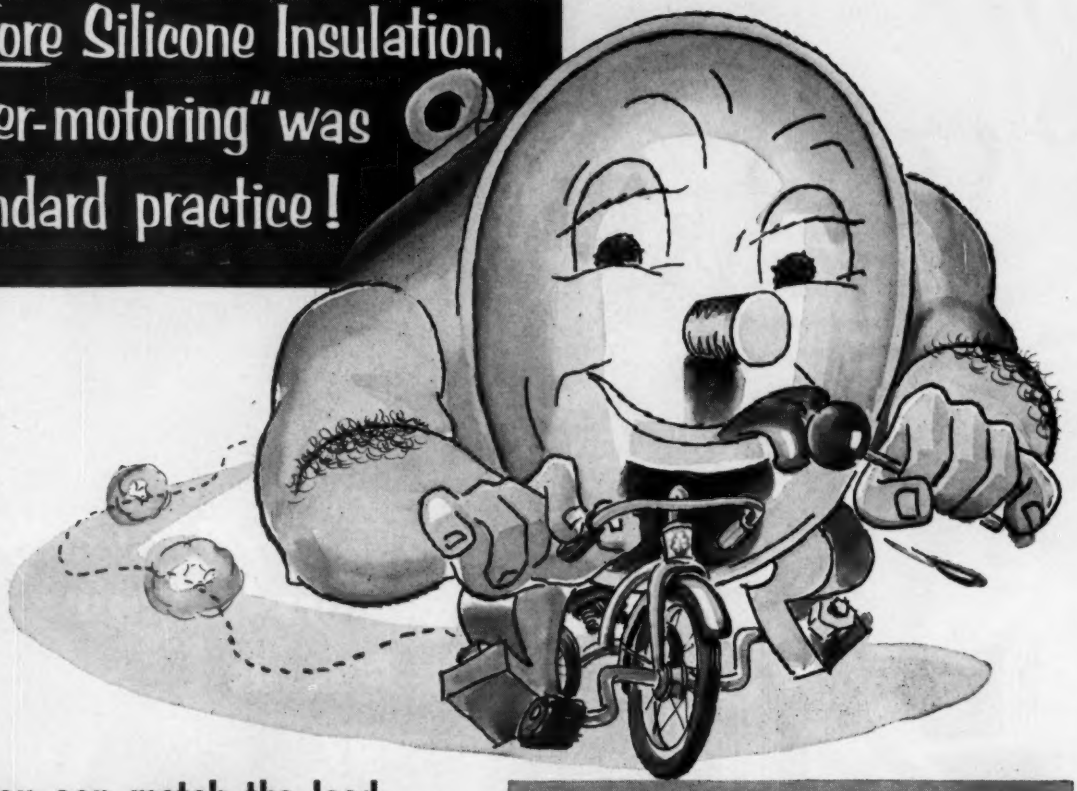
CANADA: CANADIAN PITTSBURGH PIPING, LTD., 835 BEACH ROAD—HAMILTON, ONTARIO

PP-18

OFFICES IN PRINCIPAL CITIES

Atlanta	Whitehead Building
Boston	10 High Street
Chicago	Peoples Gas Building
Cleveland	Public Square Building
Hollywood	1828 North Alexandria Ave.
New Orleans	P. O. Box 74
New York	Woolworth Building
Syracuse	113 So. Salina Street
Toronto	68 Yonge Street

Before Silicone Insulation, "over-motoring" was standard practice!



Now you can match the load . . . let silicones carry the overloads

Lazy motors cost money! Why continue to pay a fat premium for motors that make kid's play of their average work load? Today, you can save money by using *silicone insulated* motors rated to *match your average load*. Their built-in service factor of 25 to 50% will handle most intermittent overloads or loads that can't be matched in standard frame sizes.

Cut your capital investment and installation costs! Think of it—for every dollar dumped into *unused* motor capacity, you spend an extra $3 for starters, cable, transformer capacity and installation costs.

Enjoy more continuous production! You can depend on motors insulated with Dow Corning silicones to have maximum resistance to such motor killers as heat, moisture and corrosive atmospheres.

Remember, over-motoring is outmoded

Get sources for silicone insulated equipment—mail coupon today

Dow Corning Corporation, Dept. 6907, Midland, Mich.

Please send me sources of supply for new Silicone (Class H) ☐ Motors ☐ Transformers

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ ZONE ____ STATE _____

Rolling up more evidence...

R. G. LeTourneau, Inc. of Longview, Texas, installs a silicone insulated d-c motor in each of the 24 electric wheels of the giant "Sno-Freighter." Silicone insulation is used to give maximum power per pound under tough operating conditions. The silicone insulated motors, located in tubular axles and connected through a gear train in the wheel hubs, demonstrate the advantages of placing the power unit close to the work . . . a basic principle made practical by the heat stability of Dow Corning silicone dielectrics.

DOW CORNING SILICONES

DOW CORNING CORPORATION
MIDLAND, MICHIGAN

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS
DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C. (Silver Spring, Md.)

CANADA: Dow Corning Silicones Ltd., Toronto
GREAT BRITAIN: Midland Silicones Ltd., London
FRANCE: St. Gobain, Paris

brier, White Sulphur Spings, W. Va. Details from SFSA, 606 Terminal Tower, Cleveland 13, Ohio.

Oct 1-5—American Institute of Electrical Engineers, Fall General Meeting. Morrison Hotel, Chicago, Ill. Details from AIEE, 33 W 39th St, New York 18, N. Y.

Oct 8-10—American Society of Mechanical Engineers and **American Society of Lubrication Engineers,** 3rd jointly-sponsored Lubrication Conference. Chalfonte-Haddon Hall, Atlantic City, N. J. Details from ASME, 29 W 39th St, New York 18, N. Y. or from ASLE, 84 E Randolph St, Chicago, Ill.

Oct 22-26—44th National Safety Congress and Exposition, Conrad Hilton, Congress, Morrison and La Salle hotels, Chicago. Further information from National Safety Council, 425 N Michigan Ave, Chicago 11, Ill.

Open library devoted to solar energy

► A LIBRARY devoted exclusively to solar energy is operating at the headquarters of the Association for Applied Solar Energy, 204 Heard Building, Phoenix, Ariz.

The library contains more than 2500 references in the form of technical papers, articles and patents—all dealing with solar energy research and development. The few existing books on the subject are also in the library.

Among the most important new additions to the library are the 32 papers presented at the World Symposium on Applied Solar Energy and the 96 papers delivered at the Tucson Conference on the Scientific Basis of Solar Energy.

New electric power generator is Connecticut's largest

► CONNECTICUT'S LARGEST electric power generator has gone into commercial operation in a new plant adjacent to The Connecticut Light and Power Co's original steam generating station at Devon, near the mouth of the Housatonic River.

The new 105,000-kw turbogenerator is capable of providing enough electricity to supply the average requirements of a city the size of Waterbury and its environs. Teamed with Devon's six turbogenerators operating at the original plant it will bring the station's total capacity to 383,700-kw—an increase of some 38%.

The plant addition which houses the new unit totals about 24,000 sq ft. It

A LIGHT THAT NEVER FAILS

Now Possible With Peabody Rifled Tile For Gas Fired Burners

Lost ignition need no longer worry users of gas-fired burners, even under the most adverse firing conditions. The new Peabody tile, specially designed and rifled in direct opposition to rotating air flow, in the rotating fuel and air mixture develops low-velocity eddy currents that give desired ignition. The protected burning eddies act as *a series of continuous and positive pilots* for the main body of the combustible mixture. This new tile permits *minimum load* setting of gas with rapid *maximum* settings of wind-box pressure *without loss of ignition!*

Available on new or old Peabody installations, the new Peabody Rifled Tile offers users unusually high efficiencies, plus unequalled dependability of ignition—under even the most adverse firing conditions. Write today for complete details.

PEABODY ENGINEERING CORPORATION
232 MADISON AVENUE, NEW YORK 16, N. Y.
OFFICES IN PRINCIPAL CITIES
PEABODY LIMITED • LONDON, S.W. 1, ENGLAND

6-132

ONE OF THE GARLOCK 2,000

GARLOCK 662
GASKET MATERIAL
does not shrink
or change shape

Chart shows loss of thickness after alternating wet and dry exposure tests. Garlock 662 returns to within 1% of original thickness. No. 662, made from a cork paper base impregnated with a synthetic rubber, is dimensionally more stable than (A) beater process sheet with synthetic rubber binder, (B and C) sheets saturated with glue-glycerine binder.

Here's convincing proof that gaskets of Garlock 662 can stand varying climatic conditions without drying, shrinking, or hardening. The gaskets illustrated were subjected to a 24 hour alternating wet and dry test for weeks, then conditioned at room temperature. As the photo and chart at right show, 662 gaskets returned to their original shape and to within 1% of their original thickness. Competitive types hardened, twisted, and shrank as much as 8%. No wonder so many companies are specifying 662 for use against gasoline, water, and oil at temperatures up to 300°F. It is approved by Underwriters' Laboratories, Inc. for use against hazardous liquids.

And longer-lasting 662 Gasket material is only one of "the Garlock 2,000" . . . two thousand styles of gaskets, packings, and seals to meet all your needs. It's the only complete line. It's one reason you get unbiased recommendations from your Garlock representative. Call him today or write for Bulletin AD-146.

THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, *contact one of our 30 sales offices and warehouses throughout the U. S. and Canada.*

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints

REPORTS from the FIELD

Begins on page 148

has a turbine room of approximately eight stories, attached to a boiler house of about 14 stories. The concrete stack built especially for the new unit rises 350-ft—is designed to withstand winds of more than 100 mph.

Giant press for bending steel plates installed at B&W

► A NEW TWIN PRESS for bending large boiler drum half shells has been installed at the Barberton, Ohio works of The Babcock & Wilcox Co. It has a capacity of 5000 tons, stands over 25-ft high and is capable of bending a steel plate up to 7½-in. thick and 36-ft long. A plate this size would weigh about 50 tons.

Four giant manipulator hooks powered by independent hydraulic circuits are used to place hot plates into position on the press. Each hook will lift 35 tons and is controlled by electric pushbuttons from either of two control consoles. A portable control box is provided for handling cold plate for final sizing operation.

Anthracite producers guarantee supplies of steam sizes

► ARCHITECTS, ENGINEERS and large commercial consumers of small hard coal commercial sizes were guaranteed delivery of ample supplies of fuel in a statement by the Anthracite Industry Council, released to scotch rumors of possible shortages in steam sizes.

Speaking for the Council, Truman Dodson, vice-president of Weston Dodson & Co, stated that major anthracite producing companies will collectively guarantee delivery of the small sizes of hard coal under contractural agreement. Reserves of anthracite, Dodson pointed out, are reassuring with 175 years' supply in eastern Pennsylvania.

Magnetic drives developed for high-speed feed pumps

► THE FIRST MAGNETIC slip couplings to provide adjustable speed for high-pressure boiler feed pumps operating above 3600 rpm will be installed by South Carolina Electric & Gas Co at its new Silas G McMeekin Station near Irmo, S. C. For Unit 1, three 2500-hp 1800-rpm magnetic drives have been ordered from Electric Machinery Mfg Co to drive 5000-rpm 2793-psi pumps through 1:3.045 step-up gears.

High-speed feed pumps have been developed in recent years to provide the higher design pressures required

in modern steam plants. Conventional 3600-rpm pumps (the highest speed available with 60-cycle direct-connected motors) require extra stages to develop the necessary pressure. As a result they are relatively large and costly. The high-speed pump, however, develops more head per stage—therefore has fewer stages and a shorter, more reliable shaft.

Olin Mathieson Chemical Corp to enter aluminum industry

► DETAILS OF Olin Mathieson Chemical Corp's plans to enter the aluminum industry have been announced by Thomas S Nichols, president.

The operation will mark the first time in the aluminum industry's history that coal mined directly on the site will be used to provide the large power requirements for reduction of alumina to pig aluminum. Initial investment includes approximately $90 million for the aluminum plant and $30 million for the power facilities needed for the plant.

The complete facilities will be located in the Ohio River Valley. The alumina plant, reduction plant and rolling mill will be on the Ohio River near Clarington, Ohio.

The power plant to be engineered and built by American Gas and Electric Co will be slightly upstream on the West Virginia side at Cresap Bottom and will be connected to the aluminum facilities by a high-tension transmission line. It will be built on a new major coal mine that will be constructed, owned and operated by the Pittsburgh Consolidation Coal Co. To be known as the Kammer Plant, it will consist of two units of 225,000 kw each. The plant will be designed for development up to 1,350,000-kw capacity.

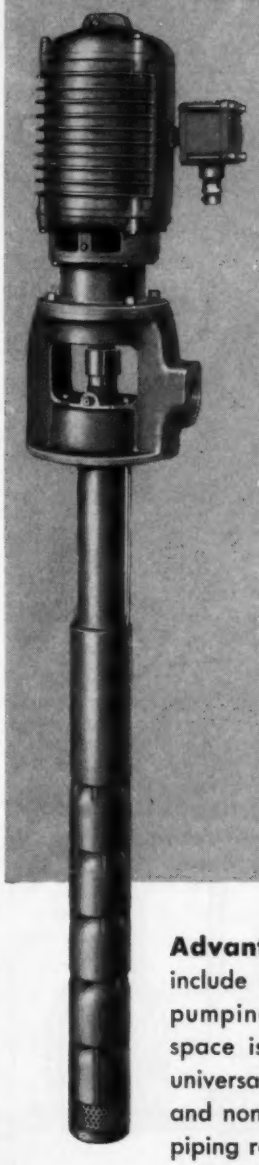
American Gas & Electric System to add largest generating units

► Two 450,000-KW coal-burning steam-electric generating units—the largest ever undertaken in the history of the electric power industry—will be built on the American Gas and Electric System, according to an announcement by President Philip Sporn. Locations for the two units on the seven-state AGE System have not been selected. Each will cost an estimated $55 million.

Mr Sporn said that the units will attain a higher level of efficiency in the production of electric power than has ever been achieved before.

Each unit will consume over 150

WIDE VARIETY OF LIQUIDS HANDLED BY DEMING INDUSTRIAL SOLVENT PUMPS



TYPICAL LIQUIDS HANDLED

Acetone	Hydraulic Oil
Acetone & Amiplene	Isopropyl Ether
Acetate-Acetone	Jet Fuel
Acetate Anhydride	Kerosene
Alkaline Solution	Lanolin
Ammonia	Methyl Ethyl Ketone Solvent
Amylene	Mineral Spirit
Anti-Freeze	Monoethanolamine
Aviation Gasoline	Octo Alcohol
Benzol	Pure Petroleum Naphtha
Benzine	Sea Water
Brines (Light)	Sodium Hydroxide Solution
Butanol	Solvesso
Caustic Soda	Styrene
Coconut Oil	Textile Finish Oil
Diesel Oil	Thinner
Ethanol	Toluene (Crude)
Ethyl Acetate	Toluene (Dry)
Ethyl Alcohol	Vinyl Acetate
Ethyl Ether	Xylene
Fuel Oil	
Hot Condensate	
Hot Paraffin	

Advantages of Deming Fig. 4703 pumps include elimination of priming difficulties as the pumping unit is always submerged; minimum space is required due to vertical construction; universal application for handling both volatile and nonvolatile liquids; no close clearances; less piping required; low maintenance and operating cost. For complete information, write to:

THE DEMING COMPANY
547 BROADWAY • SALEM, OHIO

flexibility

A mine needs flexibility too! Production flexibility so it can deliver the exact coal required by each customer.

At our Enos and Enoco Mines...

Modern preparation facilities produce consistently high quality coals!

Both mines prepare a varied range of sizes and size blends—each a truly manufactured coal!

Each mine has the production capacity to produce the coal size you need—in the quantity you need—when you need it!

Enos and Enoco's flexibility of production has licked the problem of substitution prevalent at many mines today. That's why we can guarantee prompt delivery of a tailor-made quality coal of uniform size-consist.

Place a trial order.
Make a test comparison.

THE ENOS COAL MINING COMPANY

Sales Offices for Enos and Enoco Coals

1405 Merchants Bank Bldg. Indianapolis 4, Indiana
310 S. Michigan Ave. Chicago 4, Illinois

REPORTS from the FIELD

Begins on page 148

tons of coal per hour for every one of the 8000 hours a year it is expected to operate. The fuel will be either pulverized or finely crushed.

Each boiler, to be built by Babcock & Wilcox Co, will be of outdoor design, as high as a 23-story building, and will exhaust to an individual poured-concrete stack approximately 500 ft above ground level. Boiler operating pressure of 3500 psi will be well above the critical pressure of steam, 3206 psi. Boilers will be of the "once-through" type: water entering at one end will absorb heat and in a single passage will come out as steam at a temperature of 1050 F.

Turbine-generators for the units will be built by the General Electric Co. The turbines will be of the cross-compound type—the high-pressure element operating at 3600 rpm and low-pressure element at 1800 rpm. The 3600-rpm generators will be liquid and hydrogen-cooled—the stationary part or stator being cooled by oil circulating through its hollow high-voltage windings and the rotor being cooled by hydrogen.

"Zinc controls corrosion" is title of new 16mm sound and color motion picture produced by The American Zinc Institute, Inc. Running time is about 35 minutes. It is available for showing at no charge—request special booking forms from AZI, 60 E 42nd St, New York 17, N. Y.

Dr Ugo Fano, chief of the nuclear physics section of the National Bureau of Standards, has been granted a Rockefeller Public Service Award which will allow him to complete a book on quantum physics for non-physicists.

Electric power generating capacity of Alabama Power Co's three thermal power stations in Gorgas will be increased to 711,250 kw in 1957 upon installation of a new 165,000-kw steam turbine-generator. The unit will be built by General Electric Co.

"Never mind whether the traveling grates are on. Just look those tubes over."

NEW!

PLANT OPERATOR'S MANUAL

Get quick answers to job problems—training in methods of good plant maintenance and operation. Practical manual covers scores of jobs on boilers, engines, turbines, pumps, compressors, condensers, valves, seals, and so on. Made clear by over 1500 illustrations, including step-by-step sequence views. By Steve Elonka, Assoc. Editor, **Power.** 292 pp., 1539 illus., **$5.00.**

NEW!

ELECTRONICS IN INDUSTRY

2nd Edition

A complete, simplified description of electronic circuits and equipment, this volume fills you in on the background you need without demanding any special technical training. It helps you understand the workings of all types of electronic equipment from the simplest to the more complex, brings you fully abreast of such developments as servomechanisms, transistors, magnetic amplifiers, strain gages, etc. Second edition. By George M. Chute, Prof. of Elect. Eng'rg., U. of Detroit. 440 pp., 344 illus., **$7.50.**

NEW!

REACTOR SHIELDING DESIGN MANUAL

An engineering treatment, showing how to design practical reactor shields, largely based on methods and data used for naval reactors and the Pressurized Water Reactor, which is the first large reactor for utility power generation. The influence of plant layout, structure, and maintenance upon design is taken into account. Edited by Theodore Rockwell III, USAEC. 481 pp., 269 illus., indexed, **$6.00**

PROFESSIONAL ENGINEER'S EXAMINATION

QUESTIONS AND ANSWERS

Over 500 questions and complete answers to help engineers pass state license examinations. Covers mechanical, electrical, civil, and chemical engineering, and includes engineering economics and land surveying. Latest questions—suitable for all states. Author has worked on New Jersey examination preparation for 19 years. By William S. LaLonde, Jr., 462 pp., 234 illus., **$6.50.**

10 DAYS' FREE TRIAL

McGraw-Hill Book Co., Inc. Dept. P-7
327 W. 41st St., New York 36, N. Y.

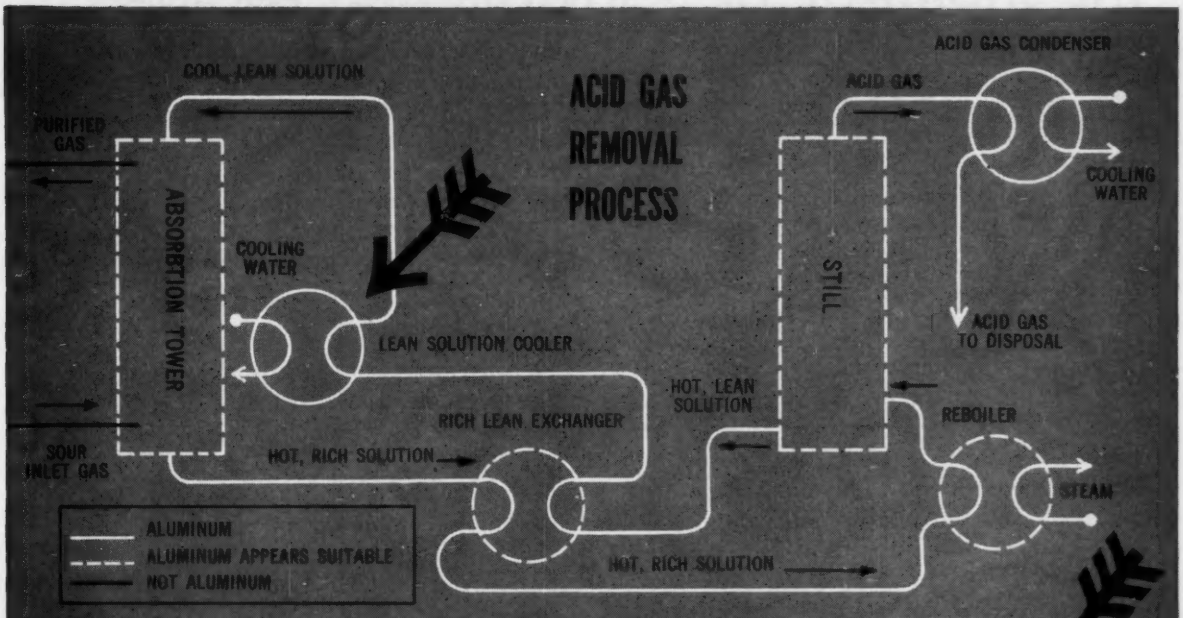
Send me the book(s) checked below for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery costs, and return unwanted book(s) postpaid. (We pay delivery costs, if you remit with this coupon—same return privilege.)

- ☐ Elonka—Plant Operator's Manual—$5.00
- ☐ Chute—Electronics in Industry, 2nd ed.—$7.50
- ☐ Rockwell—Reactor Shielding Design Manual—$6.00
- ☐ Lalonde—P. E. Examination Quest. & Ans.—$6.50

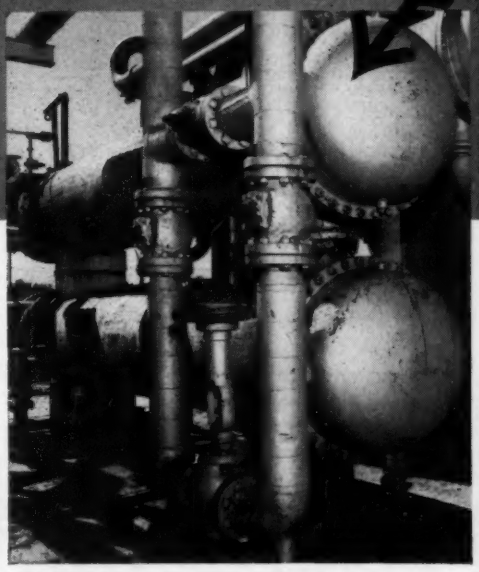
(PRINT)
Name.....
Address.....
City..... Zone..... State.....
Company.....
Position..... P-7

For price and terms outside U.S. write McGraw-Hill Int'l, N.Y.C.

Major oil company proves corrosion resistance of **ALCOA ALUMINUM** Heat Exchanger Tubes



Flow chart shows typical acid gas removal with uses of aluminum indicated. ALCOA Aluminum alloys provide outstanding resistance to H_2S and CO_2, contaminants commonly encountered in the petroleum industry. Both aqueous amine and glycol-amine solution systems employ aluminum in heat exchanger tubes, tower internals, etc. . . . for improved service life over alternate materials . . . at far lower cost. (Photograph at right shows lean MEA solution cooler referred to below.)



Over 750 days' exposure to corrosive gas contaminants has proved to a major oil company the superior resistance of ALCOA Alclad Heat Exchanger Tubes. Used in the lean MEA solution cooler of a Girbotol Gas Treater, the tubes are exposed to a solution carrying 10 grains of hydrogen sulfide per gallon at the rate of 350 gallons per minute. After more than two years of service, the aluminum tubes are virtually unaffected.

Such service records have proved time and again that ALCOA Alclad Aluminum Tubes withstand corrosion best. Materials like hydrogen sulfide and carbon dioxide—normally corrosive to most metals—are not corrosive to aluminum. That means longer service life, less maintenance—to reduce process operating costs.

What's more, ALCOA Aluminum Heat Exchanger Tubes in the common sizes cost far less than seamless tubes of other common materials . . . one-half as much as Admiralty brass . . . one-third to one-fifth as much as cupronickel or stainless steel. It will pay *you* to use the handy coupon today for complete details.

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

ALUMINUM COMPANY OF AMERICA
888-G Alcoa Building, Pittsburgh 19, Pennsylvania

Please send me your free 24-page booklet, Alcoa Aluminum Heat Exchanger Tubes

Name_____

Company_____

Address_____

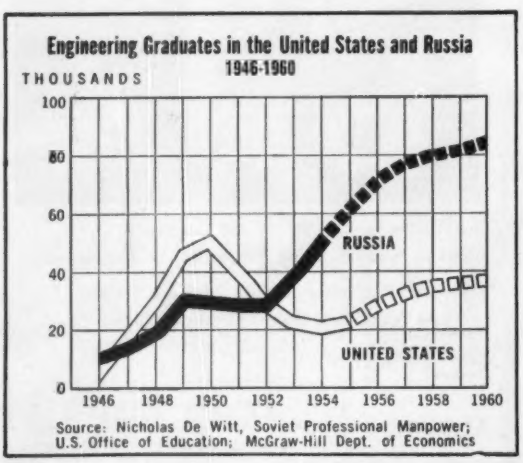
City_____ Zone_____ State_____

THE SHORTAGE OF SCIENTISTS AND ENGINEERS:

Are We Losing the Race with Russia?

THERE is new confidence in the Kremlin. One key reason is expressed in a recent boast of Communist Party Secretary Khrushchev: **"The capitalists always regard our people as being backward, but today we have more engineers and more supporting engineering technical personnel than any capitalist country."** He promised that this lead would be widened and that communism would be victorious without war.

This boast cannot be dismissed as communist propaganda. Admiral Lewis L. Strauss, chairman of the U. S. Atomic Energy Commission, has warned: **"In five years our lead in the training of scientists and engineers may be wiped out, and in ten years we could be hopelessly outstripped. Unless immediate steps are taken to correct it, a situation, already dangerous, within less than a decade could become disastrous."**



This second editorial in a series on the shortage of scientists and engineers is designed to explore as carefully as possible the facts and the implications of the new emphasis on technical training in the Soviet Union. It draws heavily from the authoritative book *Soviet Professional Manpower,* prepared for the National Academy of Sciences and the National Research Council by Nicholas DeWitt of the Russian Research Center of Harvard and released recently by the National Science Foundation.

Trend Is Against Us

If the Soviet Union already has a lead in technical manpower, it is not very great. Both the United States and Russia now have around a million scientists and engineers. About a third of the Russian engineers were trained on inferior pre-1935 standards. **It's the trend — shown in the chart — that is alarming.**

Over the last five years we have turned out only 142,000 engineers, compared to an estimated 216,000 in Russia. In 1955 our output was around 23,000 compared to their 63,000. Over the next five years our projected output is 153,000, against at least 400,000 in Russia. There will be an additional 150,000 or more in the satellites and Red China.

In Russia, 30% of the college students are in engineering, compared to 8% here. Another 30% or more take degrees in natural sciences. Moreover, unlike ourselves, the Russians are

ploughing back a large proportion of their science graduates into teaching, which implies a rapid buildup in the future.

Quality As Well As Quantity

It would be foolhardy to assume that these new Russian graduates are inferior to ours in the quality of their technical training. They start out with much more intensive mathematical and scientific preparation at the high school level. They study harder and longer in college, with more laboratory work and more practical training. Their courses and textbooks seem to be as thorough as ours. Even though the Russian graduates may be overspecialized, they get results.

These results have been striking. The Russians developed both A-bombs and H-bombs faster than we expected, and it's not certain that they had to rely much on espionage. They pushed ahead of us for a while in jet fighter design, and they showed up with a fleet of long-range bombers well ahead of schedule. They are crowding us on nuclear power, electronics and automation. There are grave fears that they have established a lead in the vital field of military rockets.

The goal of Soviet scientific manpower policy includes not only weapon supremacy but also leadership of the neutral and uncommitted areas of Asia, Africa and the Middle East. The Soviet leaders may be bluffing in their offers to export capital, but they are preparing to export Russian scientific and technical know-how in a big way.

How They Do It

The Russians are determined to win the race for scientific supremacy, and they do not count the cost. **They pay their scientists and engineers salaries that seem fantastic when compared with other Soviet incomes.**

Senior professors, research scientists and top engineers are a major segment of the Russian elite. Their incomes are frequently six to ten times the average industrial wage. (In the U. S. six to ten times the average industrial wage would be $25,000 to $40,000 a year.) Housing and other privileges are correspondingly lavish. While preaching equality, the Soviets use capitalistic incentives far more boldly than we do. Indeed, practicing engineers and scientists have been complaining about the exalted status of professors and top research people, and salary scales are now being adjusted to give greater emphasis to practical results.

The Russians are also generous in their aids to education. Tuition has just been made free at all levels. Undergraduates receive 200 to 500 rubles a month and graduate students 800 rubles (about equal to an industrial wage) to cover living expenses. The biggest stipends go to science and engineering students. College students are deferred from military service, and engineers and scientists often enjoy continued deferment even after graduation.

Finally, the Soviet leaders can channel engineers and scientists — and all other human and material resources — into any area they choose. And the areas the Soviet leaders choose are predominantly those that contribute to military or political objectives, rather than to a better life for consumers.

What's Our Answer?

We are certainly not going to adopt Soviet methods. We do not want scientific robots, but free men, able to understand and add to our democratic heritage. At the same time, our world leadership in technology — and perhaps even our survival as a nation — will be threatened if we allow ourselves to lag far behind Russia in the training of scientists and engineers. Ways to keep the United States in the race will be discussed in a later editorial in this series.

This is one of a series of editorials prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments of particular concern to the business and professional community served by our industrial and technical publications.

Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

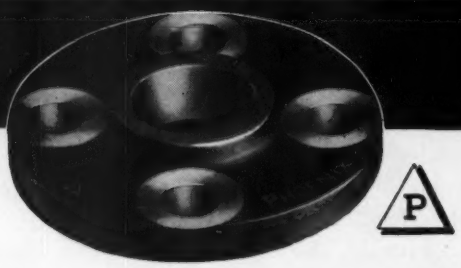
Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

PHOENIX *Drop-Forged* FLANGES MEAN...

MAXIMUM STRENGTH



Long life is assured with Phoenix maximum strength flanges. Forged of mild steel, they are available in a wide range of styles and sizes. Meet ASA requirements and ASME and ASTM specifications.

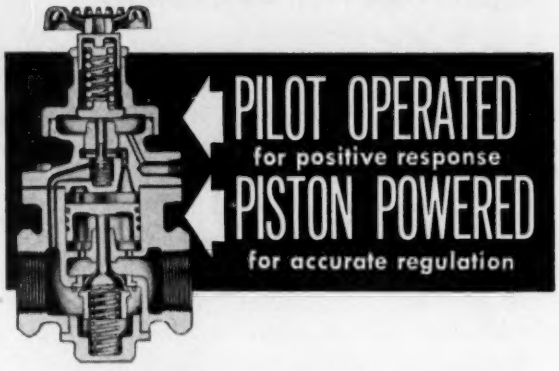
NEW CATALOG!

Send for free brochure showing Phoenix Complete Line.

FLANGE DIVISION
PHOENIX MANUFACTURING CO.
Catasauqua, Pa. • Joliet, Ill.

You can install and forget this ...self-contained pressure

REDUCING VALVE



Kieley & Mueller Type 481 Reducing Valve offers really trouble-free operation on your most difficult steam regulation services . . . yet it is sufficiently low in cost to warrant use for ALL your needs.

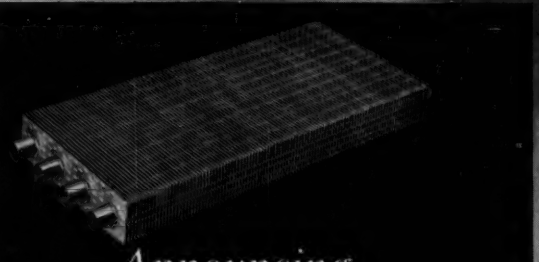
Designed for initial steam pressure of 250 lbs. or less, Type 481 has stainless steel spring and pilot, stainless steel trim. Available with screwed connections, ½" to 2".

Send for Bulletin 4000

KIELEY AND MUELLER, Inc.
pioneer in steam specialties
64 GENUNG STREET, MIDDLETOWN, NEW YORK

SO HALSTEAD & MITCHELL ENGINEERS SAID:

"Let's increase finned surface heat transfer"



Announcing
Turbu-Flo®
FINNED SURFACE

REMOTE AIR-COOLED CONDENSERS
BLAST HEATING & COOLING COILS
SPECIAL FINNED EVAPORATORS & CONDENSERS
FOR AIR CONDITIONING
SPECIAL FINNED COILS FOR REFRIGERATION FIXTURES

HM
Halstead & Mitchell

Increase turbulence of air flowing over a surface and more heat is transferred from the surface. Develop a patterned surface to build turbulence to a maximum *within the allowable pressure drop limits*—and you have the principle of Halstead & Mitchell's latest contribution—exclusive "TURBU-FLO" finned surface!

"TURBU-FLO" assures you of extra-safe capacity ratings, for the added heat transfer it provides means an unusual margin of *added* capacity.

"TURBU-FLO" finned surface is immediately available to meet your every need. Describe your needs—and ask for Bulletin DE-200.

Halstead & Mitchell, Bessemer Building, Pittsburgh 22, Pa.

Coming: MID-SEPTEMBER

Power's

MODERN PLANT YEARBOOK

Here are five useful, lasting, timely departments which make the MODERN PLANT YEARBOOK the exclusive reference book in the power and plant services.

1. MODERN PLANT SURVEY

New Plants for 1956: Designs trends, tabulated data on more than 500 steam and hydro units on order, being built and just completed.

2. MODERNIZATION AWARDS

Field-tested profit-making ideas. Listing of awards for modernization accomplishment.

3. DIRECTORY FOR MODERNIZATION

Source book of power equipment and services; over 700 products and 1800 firms.

4. CROSSFILE OF OBSOLESCENCE

Former manufacturers of power and plant service equipment: names and addresses of successor companies.

5. THE SHOWCASE

New Equipment: A review of problem-solving products with cards for ordering more info. New Bulletins: Handy guide to literature and catalogs available.

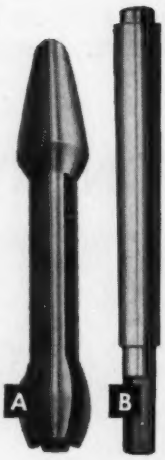
"AN EXTRA SERVICE TO ALL SUBSCRIBERS"

Wilson Tube Cutter

CUTS COSTS!

The Wilson Tube Cutter costs two to eight times less than competitive tools. You also get a tube cutter with eight exclusive features:

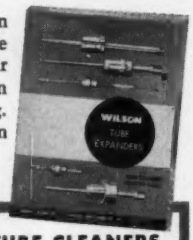
(1) It has fewer working parts. (2) It can cut non-ferrous tubes in under four seconds. (3) You can chuck it into your own air or electric drill. (4) It has a replaceable spacer collar to adjust for tube thickness. (5) The cutter bit retracts after withdrawal of the cutter. (6) You have a choice of round or taper shank in smaller sizes. (7) To operate, you insert the cutter in the tube, switch on the power, and press forward. (8) It takes the punishment of constant use.



A Tube Pilot guides tubes through baffles and far sheet when retubing.

B Tube Knockout tool for manual or mechanical use.

It makes good sense to buy the Wilson Tube Cutter and accessories. For some more suggestions that will cut your tube maintenance costs, write for Wilson comprehensive Tube Expander Catalog. For tube cleaners, send for Wilson Catalog 77.



Don't Forget!

For cleaner cleaning WILSON TUBE CLEANERS

For easy, accurate tube rolling WILSON TUBE EXPANDERS

Representatives in principal cities

THOMAS C. WILSON, INC. • 21-11 44th Ave., Long Island City 1, N.Y.

Cable address: "Tubeclean", New York

TW 851

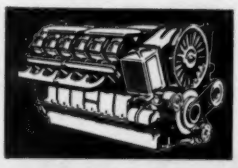
WILSON

TUBE CLEANERS • TUBE EXPANDERS

DEUTZ

DIESEL

began in 1948 to build air-cooled DEUTZ diesel engines in large series. 7 years after, in 1955, the oldest engine manufacturers in the world had built and sold 150.000 air-cooled DEUTZ diesel engines totalling 7.5 Million B.H.P. These equipment engines are used all over the world for every kind of application. DEUTZ builds air-cooled 1 to 12-cylinder diesel engines with an output range from 5 to 250 B.H.P. for road vehicles, rail vehicles water craft, working machines in all fields of application, generator sets for stationary and mobile electric and power plants.



air-cooled

KLÖCKNER-HUMBOLDT-DEUTZ AG. KÖLN

Address inquiries from U.S.A., Alaska, Hawaii and Puerto Rico to:

DIESEL ENERGY CORPORATION

82 Beaver Street, New York 5, N. Y.

Announcing:

AN EDITORIAL PROGRAM OF MAJOR SIGNIFICANCE

POWER TO GROW...*electrically*©

POWER's editors have just initiated a series of meetings with leading engineers of the electrical industry—meetings designed to focus technical thinking on a problem of urgent concern to that industry . . . and all industry.

In a word, it's the challenge of growth. In their industry contacts, POWER editors see many plants where production is even today limited by inadequate electrical systems. More important, many industrial plants now being built will feel the pinch in a few years because their electrical systems are not designed with the capacity and flexibility to meet the needs of a dynamic future.

From their meetings with the technical leaders in the electrical field, POWER editors will build a program to demonstrate industry's need for *power to grow*. And to show in detail how new or modernized in-plant electrical systems should be designed to insure that there *will be* power to grow.

This POWER TO GROW . . . *electrically* program will begin in the September issue with a documented statement of the problem. Then, in a year-long series, succeeding feature articles will deal with each part of the in-plant electrical system—from primary substation out to the point of application on production machinery. Each article will summarize today's best practice. Each will show how to apply that practice to insure the flexibility and capacity to meet tomorrow's demands. And each will include case material demonstrating how *power to grow* has been provided by forward-looking industrial-plant electrical designers.

This POWER TO GROW . . . *electrically* program is a natural extension of the thinking that led to the Nuclear Energy Seminars recently sponsored by POWER. In these, we examined the meaning of the atom for manufacturers of power field equipment and its impact on the business of *power generation*. *Now* we are looking at the job of *distributing energy* in industrial plants, and particularly the problems an expanding economy poses for both makers and users of electrical equipment. Response to the Nuclear Energy Seminars demonstrated their importance as a contribution to industry thinking. We are confident this new editorial program will make a similar contribution.

McGraw-Hill

ABP•ABC

HILL PUMP VALVES

Since 1909

● The valve with the renewable feature restores old pumps to original efficiency. Constant contact is maintained over the full bearing surface no matter in what position the valve rotates because of the exclusive HILL design. Efficient, durable, economical, accurate.

Write for Bulletin

HILL PUMP VALVE CO.
2728 Elston Ave., Chicago 47, Ill.

WHERE TO BUY

Featuring additional products specialties and services for power plants

Master **GLASSES**

HIGH PRESSURE GASKETS

All sizes to fit your gages
ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

STEEL PIPE & TUBING
● CHROME MOLY ● CARBON MOLY
● MONEL ● CARBON STEEL ● STAINLESS
● HASTELLOY
Widest Range of Sizes & Specs in the U.S.
WRITE FOR STOCK LIST
MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

PROFESSIONAL SERVICES

CONSULTING · CONSTRUCTION · DESIGN · PLANS · EXAMINATIONS · SURVEY • REPORTS · PATENTS · TRADE MARKS

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction,
Investigations, Valuation and Rates
1706 Broadway Kansas City 12, Missouri

THE LUMMUS COMPANY
Engineers and Constructors
385 Madison Ave., New York, N. Y.
Chicago . . Houston . . London
Paris . . The Hague . . Montreal
Caracas . . Bombay

SEELYE STEVENSON VALUE & KNECHT
Consulting Engineers
Mechanical—Electrical—Civil
Surveys Reports Design
101 Park Avenue New York 17, N. Y.

BURNS & McDONNELL
Engineers—Architects—Consultants
Kansas City, Mo. Phone
P. O. Box 7088 DElmar 3-4375

LUTZ AND MAY COMPANY
Consulting Engineers
Steam, Gas & Diesel Power Station
Pumping Plants—Electric Systems
Reports—Design—Appraisals
1009 Baltimore Kansas City 6, Mo.

J. E. SIRRINE COMPANY
Engineers
Power Plant Design — Consultations Reports
Water — Steam Utilization — Plants
Greenville South Carolina

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Design and Construction Supervision
Industrial • Sanitary • Chemical Laboratory Services
Business and Economic Research
Industrial Relations • Purchasing
New York Reading, Pa. Washington

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting & Other Operations
231 So. La Salle St. Chicago 4

STANLEY ENGINEERING COMPANY
Consulting Engineers
327 S. La Salle Street Hershey Building
Chicago 4, Illinois Muscatine, Iowa

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign
74 New Montgomery St., San Francisco 5, Calif.

FRANK C. REYNOLDS
Registered Consulting Engineer
Surveys, Reports, design and construction supervision of air conditioning, heating, ventilating, oil and gas burners & control systems.
136 Liberty St. New York 6, N. Y.

SWANSON, WRIGHT & CO. ENGINEERS LTD.
Consulting Engineers
Industrial and Process
Forest Products Industries
Power Plants
Reports, Specifications, Designs, Supervision
2210 West 12th Ave., Vancouver 9, B.C. CEdar 1154

THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical
1200 N. Broad St. Philadelphia 21, Pa.

SANDERSON & PORTER
Construction
REPORTS SURVEYS
New York New York

WATER SERVICE LABORATORIES, INC.
Specialists in Water Treatment for Corrosion Prevention
Main Office:
423 W. 126 St. New York 27, N. Y.

PETER F. LOFTUS CORPORATION
Design and Consulting Engineers
Electrical • Mechanical • Structural
Civil • Thermodynamic • Architectural
First National Bank Building
Pittsburgh 22, Pennsylvania

SARGENT & LUNDY
Engineers
140 South Dearborn St. Chicago, Illinois

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant
Positions Wanted
Part Time Work

Civil Service Opportunities
Selling Opportunities Wanted
Selling Opportunities Offered

Employment Agencies
Employment Services
Labor Bureaus

DISPLAYED —**RATES**— **UNDISPLAYED**

The advertising rate is $25.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

$1.65 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.

Box Numbers—counts as 1 line.

Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Not subject to Agency Commission.

Send NEW ADS or Inquiries to Classified Adv. Div. of POWER, P. O. Box 12, New York 36, N. Y. for August issue closing July 10th

SENIOR ELECTRICAL ENGINEER

Foreign Employment

Graduate EE with minimum 10 years' supervisory experience in utilities systems planning, study and design work. Must be generally familiar with power generation, transmission and distribution. For The Hague, Holland Engineering Office. Generous salary plus rent allowance. Liberal all-inclusive benefit program.

PROCESS ENGINEER

Graduate EE or ME with minimum 5 years' experience. To handle technical aspects of power plant with gas combustion turbine integrated with steam plants, electrical motors, distribution and automatic control systems. Two years' supervisory experience desirable. For Operations Department located in Saudi Arabia. Generous salary plus living allowance; liberal all-inclusive benefit program.

Write giving full particulars regarding personal history and work experience.

Recruiting Supervisor, Box 150

ARABIAN AMERICAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, NEW YORK

STEAM POWER PLANT ENGINEER

Are you a graduate mechanical engineer with ten years experience in the design and operation of steam plants?

If you are familiar with the latest turbine-plant practice, you may qualify for a responsible position as one of our power-plant consultants at the Braun Engineering Center in Southern California.

You will do preliminary engineering and make economic studies for new power station projects. You will work with our combustion engineering group on boiler design, heat balance, and combustion control, and with our instrument group on power station instrumentation.

Your inquiry will be confidential. Please write to the head of our Personnel Department, Mr F B Stratford.

C F Braun & Co

ALHAMBRA CALIFORNIA

ESTABLISHED 1909

Serving the industrial process industries, oil-refining, natural gas, chemical processing, ore-processing and power generation

MANUFACTURER'S REPRESENTATIVES:

to sell heavy industrial stokers and municipal incinerators for an old multi-line company. Several very desirable territories available. Reply

RW2123 POWER
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.): Address to office nearest you c/o this publication, Classified Adv. Div.
NEW YORK: P.O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITION VACANT

High Pressure Steam Plant Operating Personnel under 35 for new plant now under construction in Southern California. All classifications will be considered. Applicants must be experienced and qualified to perform all duties of positions for which they apply. P-1866, Power.

POSITIONS WANTED

Mechanical Engineer, College graduate, age 40, 18 years experience in supervision, operation, and maintenance of steam electric power generating plants. Desire station superintendent or responsible position with utility or large industrial plan. PW-1656, Power.

SELLING OPPORTUNITY OFFERED

Manufacturer of surface condensers, feedwater heaters, oil heaters & coolers and pressure vessels, located in New Jersey, requires additional sales representatives. Contacts in Power and Industrial Plants desirable. RW-1953, Power.

MECHANICAL ENGINEERS & DRAFTSMEN

Two graduate, licensed Mechanical Engineers with at least 10 years experience in design and preparation of plans and specifications for Power Plants, Central Heating Plants, Steam Distribution Systems and related Mechanical Engineering Projects.

Two Engineering Draftsmen experienced in preparation of plans for Power Plants, Central Heating Plants & Steam Distribution Systems and related Engineering Projects.

P-1839 POWER

330 W. 42 St. New York 36, N. Y.

WANTED ASSISTANT CHIEF ENGINEER

Graduate Mechanical Engineer, or equivalent, with a minimum of three years experience in high pressure power plant operation. A high caliber man is required in the operation and maintenance of 1250 pound pressure, pulverized fuel fired, steam-electric power plant located in the midwest.

Write stating education, experience, salary expected, and availability. All replies will be held confidential.

P-1582, POWER

520 N. Michigan Ave., Chicago 11, Ill.

ENGINEER, Design

ADVANCED DESIGN GROUP
AIRCRAFT NUCLEAR
PROPULSION PROJECT

At General Electric's ANP Department esprit de corps is part of the work-environment. This is because the application of nuclear power for aircraft propulsion offers the qualified engineer the opportunities for personal achievement that go with professional challenge.

A responsible position is now open for an engineer interested in this field: must have an engineering degree, several years diversified experience in analysis and design of power plant components, including design of nuclear reactors. The job carries the responsibility for preliminary design analysis of power plants, and directing completed scale design and layout drawings of power plants and equipment.

Publication of research results in the appropriate classified or open literature is encouraged.

OPENINGS IN CINCINNATI, OHIO
AND IDAHO FALLS, IDAHO

Address replies, stating salary requirements, to location you prefer

W. J. KELLY
P. O. Box 132
Cincinnati, O.

L. A. MUNTHER
P. O. Box 535
Idaho Falls, Idaho

GENERAL ELECTRIC

MECHANICAL PLANT BETTERMENT ENGINEERS

M. E. GRAD. PREFERRED
5-15 YRS. EXPERIENCE

Operation and betterment of steam electric plants—Diesel experience helpful. Permanent position.

Required by Operating Division of long established service and supervisory organization for large group of Electric Utilities located eleven Latin American countries. Some travel. Location New York. Usual employe benefits. Reply giving age, education, experience, personal particulars and salary expected.

AMERICAN & FOREIGN POWER COMPANY, INC.
AND SUBSIDIARIES

2 Rector Street, New York 6, New York
21st Floor DI 4-4400 Ext. 8494

ENGINEER

Immediate opening in Petro-Chemical field for recent graduate to select pump and compressor equipment. Involves liaison between customers and manufacturer's engineers.
Excellent opportunity for professional growth in engineering and administration. Location N. Y. C. Many employee benefits. Send resume including salary requirements to:

P2130 POWER
Class Adv. Div. PO Box 12 NY 36

MECHANICAL ENGINEER

Graduate mechanical engineer interested in power plant design work. Experience not required. Excellent opportunity with consulting engineering firm in Middle West. Liberal benefit plans and good working conditions.
Send resume of education and experience with statement of salary requirements.

P-1813, POWER
520 N. Michigan Ave., Chicago, Ill.

An employment advertisement in this EMPLOYMENT OPPORTUNITIES section will help you find the engineers you need. It's an inexpensive, time saving method of selecting competent personnel for every engineering job in the Power Field.

UNIQUE POSITION IN CHEMICAL INDUSTRY

Electrical Control and Power Design Engineer

Graduate E.E.; 2-5 years experience in design or maintenance. Responsible for integrated electrical design of new chemical plant facilities. Write in confidence to:

Mr. W. T. DURRETT,
Director of Engineering
Inorganic Chemicals Division
MONSANTO CHEMICAL COMPANY
St. Louis 1, Missouri

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

UNDISPLAYED —RATES— *DISPLAYED*

(Not Available for Equipment Advertising)

$1.65 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Box Numbers count as one line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.

The advertising rate is $17.90 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.
An advertising inch is measured ⅞" vertically on one column, 3 columns, 30 inches to a page.

Send new ads or inquiries to Classified Adv Div. of POWER, P. O. Box 12, New York 36, N. Y.

APPLICATION ENGINEERS

28-45, mechanical graduate or equivalent experience in combustion, design, operation, sales or development of heating or power plant, stokers, burners, or coal-handling equipment. Will manage engineering service and promotion in one of these territories: Indiana, Illinois, W. Pa., or all of New England. Unusual opportunity in a new department. Starting salary: $7,000 to $10,000 depending on experience. Company will pay moving expenses and fees. Send complete resume of qualifications and experience to:

P-1875 POWER
330 W. 42 St. New York 36, N. Y.

GET 2nd ENGINEER PAPERS IN 1 YEAR

(Yes, get better stationary engineers License!)

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

FOR SALE

Fairbanks-Morse Diesel Engines

Model 32 E 14 - 2 Cylinder 150 H.P. at 300 R.P.M. - Almost New - Price Cheap - 2 Available - Write for Full Specifications.

Globe Trading Company
1815 Franklin St. - Detroit 7, Mich.
Phone WOodward 1-8277

Turbogenerators & boilers
Mercury arc rectifiers
Diesel generators
Sub station equipment

OHIO POWER MACHINERY COMPANY
13661 Euclid Ave. Cleveland 12, Ohio

MECHANICAL ENGINEER-POWER

Recent graduate, veteran, to understudy plant engineer, national chemical company. Indianapolis location. Salary $450-550 month start. Write age, education, experience.

P-1909, POWER
330 W. 42 St., New York 36, N. Y.

Prepare for
REFRIGERATION LICENSE

More than 300 multiple choice questions from past exams. Many sketches. 96 pages 8½" x 11". Send $3 to:

W. D. TURNER
44 West 63rd St., New York 23, New York

COMPLETE SWITCHBOARD
DESIGN & CONSTRUCTION
USED & REBUILT EQUIPMENT
DIESEL SALES & SERVICE
GENERATORS—GAS OR DIESEL

UNIVERSAL POWER ENGINEERING CO.
217 COLDEN ST., JERSEY CITY, N. J.
Phone: DElaware 2-8300

WANTED

Assistant professor in electrical technology at community college of State University of New York. B.S. in E.E. and industrial experience desirable. $6200-$8800. 10-month teaching. Write to

C. C. TYRRELL
Broome County, Technical Inst. Binghamton, N. Y.

WANTED

Steam Engine Generator Sets • Turbines • Condensers • Generators • Boilers or Complete Power plants.

PAUL OBERMAN
1910 Delmar St. Louis, Mo.

WANTED

THREE VERTICAL STEAM ENGINES, Troy type, 30 to 60 HP; 9" x 9" minimum, in good working order.

KENTUCKY COLOR & CHEMICAL CO.
600 North 34th St., Louisville 12, Kentucky

SPECIAL: A 10,000-KW. @ 80% P.F., Or 12,500-KVA., Complete

GENERAL ELECTRIC TURBINE-GENERATOR SET: GOOD

FOR 400# (WITH CHANGES): WAS OPERATED AT 250#, 600° F.

12,500-KVA., General Electric Turbine-Generator is a Special Offering. Is complete with all accessories, including a 15,000 sq. ft., C. H. Wheeler, 2-pass Surface Condenser, with all auxiliaries, a complete Switchboard and an 85-KW., Direct Connected Exciter. Generator voltage is 3/60/13,800-Volts. Machine is our own property. Can make Immediate Delivery. Drawings and any further information desired will be furnished on request.

WE INVITE CORRESPONDENCE

Send Us Your Specs. for Anything Wanted in POWER EQPT.

CHARLES WEAVER
19701 James Couzens Highway
Detroit 35, Michigan

TELEPHONE BROADWAY 3-1901

NEW 25 CYCLE — MOTORS AT LONG DISCOUNTS

Qu.	HP	Make	Phase	Volts	Brg.	Frame	RPM
16	¾	Was.	1	110/220	SL	48X	1425
9	½	Was.	1	110/220	SL	48X	1425
10	½	Whse.	3	220/440	SL	145	1425
8	¾	Whse.	3	220/440	SL	186	1425
3	¾	Whse.	3	550	BB	186	1425
3	¾	G.E.	3	220	SL	77	1425
3	1	L.A.splash	3	550	BB	224	1450
5	1	Whse.	3	220/440	SL	FX224	1450
7	2	L.A.splash	3	550	BB	FX225	1450
5	3	L.A.splash	3	550	BB	FX254	1450
1	5	L.A.splash	3	550	BB	FX284	1450
3	10	L.A. XP	3	220/440		JEX364	1450
1	15	G.E. used	3	220/440		365	1450
1	25	Rel. XP	3	220/440		405	1450

TRANSFORMERS

80—1½ KVA, Line Material, Dry tpe, 120/240/480 volt primary to 120/240 volt secondary with taps. 1 phase, 60 cycle
3—250 KVA, General Electric, OISC, 2300 volt primary, 460/230/115 volt secondary, 1 phase, 60 cycle
6—500 KVA, Westinghouse, OISC, 2300 volt primary, 460/230 volt secondary, 1 phase, 60 cycle.

BENSON-WILIMZIG, INC.
1704 N. 8th St., St. Louis 6, Mo.
Phone GArfield 1-4290

3 NEW BOILERS

Available at fraction of new cost

BABCOCK & WILCOX single uptake controlled superheat marine type express boilers, 3 drums, with economizers.

Designed pressure	634 lbs.	Steam temperature	850°F
Operating pressure	550 lbs.	Furnace volume	1473 cu. ft.
Superheated steam	221,000 lbs /hr.	Total generating surface	9338 sq. ft.
Saturated steam	32,000 lbs./hr.	Superheater surface	1620 sq. ft.
Full power total	253,000 lbs./hr.	Economizer surface	3843 sq. ft.

NOTE: These boilers are new and complete. They are erected and ready for use and should therefore be considered only for such places as can be reached by water transportation.

HUGO NEU CORPORATION
31 Nassau St. Tel: REctor 2-1334 New York 5, N. Y.

DIESEL GENERATOR SETS

1—720 HP Fairbanks Morse Model 33, 5 cyl. 257 RPM, 580 KVA F-M 3/60/2400 V generator.
1—560 HP Fairbanks Morse Model 33, 4 cyl. 257 RPM, 470 KVA F-M 3/60/2400 V generator.
1—750 HP Superior 8 cyl. 400 RPM, 500 KW Elec. Mchy. 3/60/2400 V generator and auxiliaries.
1—400 HP Superior 4 cyl. 400 RPM Model VDSE, 250 KW, 3/60/2400 V.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. • St. Louis 1, Mo.

—TRANSFORMERS—

BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.
Custom-built transformers and coils manufactured to your specifications.
Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

THE ELECTRIC SERVICE CO., INC.
5318 Hetzel St. Cincinnati 27, Ohio
40 Years' Dependable Service

BELYEA RE-NU-BILT
LARGE ELEC. POWER EQUIPMENT
SELECTED STOCK ITEMS

RE-NU-BILT—GUARANTEED—RE-NU-BILT
COMBINATION MILL DRIVES — 15/2500 HP
D.C. MOTORS WITH M.G. SETS & CONTROLS

Qu.		MAKE	TYPE	VOLTS	R.P.M.
1—	2200 HP	G.E.	MCF-12	600	400/500
	22001KW	G.E.	Syn.	2300/4600	514
1—	1250 HP	G.E.	MCF	600	600/750
	1000 KW	G.E.	Syn.	2300/4600	720
1—	1000 HP	G.E.	MCF-8	600	350/700
	1000 KW	G.E.	Syn.	2300/4160	720
1—	200 HP	G.E.	CD-1650Z	250	500/1500
	200 KW	Whse.	Syn.	440	1200

ALSO MANY OTHER COMBINATIONS

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	H.P.	Make	Type	Volts	Speed
1	1500	G.E.	MT	6600	257
1	1500	G.E.	MT	6900	1187
1	1100	G.E.	IM	2300	720
1	1000	A.C.	Mill	2300	240
1	800	G.E.	MT	2300	293
1	750	G.E.	MT-573	2200	1190
1	700	Al. Ch.	D.P.	2300	500
1	500	Whse.	CW	550	350
1	400	Whse.	CW-968A	440	1176
1	400	Whse.	CW	440	514
1	400	Whse.	CW-1218	2200	435
1	350	G.E.	IM-17A	440/2200	720
1	250	G.E.	MT-424Y	4000	257
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
1	150	Whse.	CW30E17	2300	435
2	125	A.C.	ANY	440	865

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
2	650	G.E.	FT-559BY	440	3570
2	450	Whse.	CS-1426	2300/4150	354
1	400	G.E.	1E-15B	2300	1165
1	400	G.E.	1K	2200	500
1	200	G.E.	IK-17	440	580
3	200	G.E.	KT-557	440	1800
1	150	Whse.	CS	440	580

SYNCHRONOUS

1	7000	GE	ATI	2240/6600	600
1	4350	C.W	3501-SL	13800/6900	514
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900
2	2000	Whse.		2300	120
1	1100	G.E.	ATI	2300/4600	900
2	500	G.E.	TS-7567	2200	1200
1	450	Whse.		2200	450

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
1	3000(3U)	G.E.	514	600	4000/6600/13200
2	2000/2400	G.E.	450	250/300	2300/4600
1	2000	G.E.	500-25cg	660	11000
2	2000	G.E.	514	600	4600/2300
1	1750/2100	G.E.	514	250/300	4800/2400
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	514	250	2300/4600
1	1250	Whse.	720	600	2300
1	1000	G.E	900	260	6600
1	750	Whse.	900	250	2300/4150
1	750	G.E.	720	125/250	2300/4600
1	500	Whse.	900	125/250	440
1	150	Whse.	1200	600	2300
1	150	Whse.	1200	275	2300

WELDING M.G. SET

Gen. Elec.—1100 Kva—0.7 p.f.—2300/4600 V. 3/60
Generator with 1750 Kva—.8 p.f.—2300 V. 3/60
motor complete with exciter set and controls.

TRANSFORMERS

Qu.	KVA	Make	Type	Ph.	Voltages
1	3000	A.C.	OISC	3	33000x2400/4160
1	2500	Al.Ch.	OISC	3	34500x13200
1	2500	Al.Ch.	Pwr.	3	13800x147/113
3	500	Kuhl	OISC	1	13800x6900
3	333	G.E.	H8	1	7200x2400x4160Y
3	333	G.E.	H8WR	1	2300/4000x230/460
3	333	G.E.	HD	1	13200x2530x4350Y
3	200	Whse.	OISC	1	13200x120/240

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltages
1	5000	G.E.	60/50/60	6600/11000/6600
2	2500	G.E.	25/62.5	2300/2300
1	1000	G.E.	25/58.3	4400/2300
1	500	Al. Ch.	25/60	11000/2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	4000	G.E.	Condensing 425 — 750 F.T.T. Surface Condenser 3/60/2300/4000 V Direct con exciter.
1	1500	Whse.	Auto extraction 190 lbs. — 660° F.T.T. 60 lb. extraction 3/60/240 V. Div. conn. Exc.
1	1000	Moore	Auto-Ext. Cond 175/200# U.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 430/3/60.

BELYEA COMPANY, INC.
43 Howell St., Jersey City 6, N. J.

---

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
800	2300	Whse.	900
500	220v	G.E.	450
450	440	Whse.	514
400	4000/2300	Whse.	450
400(2)	2300	G.E.	900
300	2200/440	G.E.	720
300	440	G.E. (hoist)	600
300	440	Whse.	3600
250	2200/440	G.E.	1200
250	440/220	Whse.	600
250	550/440	G.E.	1200
225	4000/2300	G.E. (hoist)	600
200	440/220	Whse.	514
150(2)	440/220	G.E.	720
150	2200/440	G.E.	600
125	550/440	G.E.	1200
125	2200	G.E.	600

SYNCHRONOUS MOTORS 3-Ph 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
375	2200	Whse.	G	900
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
250	2200/440	G.E.	TS	720
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

H.P.	Volts	Make	Type	Speed
600	2200	G.E.	FT	3600
500	2200/4000	Elliot	SC	1800
400	2300/4000	Whse.	CS	720
409	2300/4000	G.E.	K	1800
350	440	G.E.	KT	1200
300	2300/4000	L. Allis	FS	1800
250	2300	Whse.	CS	600
250	2300	G.E.	K	900
225(2)	2200/440	G.E.	KT	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	JK	600
200	2200	G.E.	KT	1800
150	2200	Al. Chal.	AR	1800
150	220	Whse.	CS	1200
150	440/220	G.E.	KT	720
150	2200/440		KT	600

A. C. GENERATORS

1—320 kva, 660 rpm 2300/440/220 V., G.E.
1—300 kva, 900 rpm, 2200 V., Whse.
1—225 kva 60 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm 2200/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

2—2000 amp. GG E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V. G.E.
1—400 Amp., Condit, 3P, 25 KV outdoor
1—400 Amp., R. Smith, 3P, 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	2870
150	230	El. Dyn.	B/brg.	600
150	230	Whse.	SK	1750

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	2200	Syn.	250
240	G.E.	4000/2300	Syn.	250
175	G.E.	220/440	Syn.	230
150	Whse.	440/220	Sq. Ca.	275
125	G.E.	4000/440	Syn.	125
125	G.E.	440/220	Syn.	250/125
100	Al. Ch.	220/440	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—1000 kva, Whse., 13,800—2300 V., 3 ph., New
1—600 kva, Standard, 13,800—2300 V., 3 ph.
3—333 kva, G.E., 23000/11500—2300 V.
3—333 kva, Mol. 13,800—2300 V.
3—333 kva, G.E., 2400—480 V.
2—300 kva, G.E., 4150—240 V., 3 ph., Pyr.
3—200 kva, Mol., 13,800—2300 V.
3—200 kva, G.E., 2300—575 V.
3—100 kva, Al. Ch., 2400—480/240 V.

only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

---

3 NEW VERTICAL CIRCULATING PUMPS
STEAM TURBINE DRIVEN

Manufactured by Warren Steam Pump Co.—26,500 GPM at 13.5 lbs. and 840 RPM. Test pressure 50 lbs.—submergence 72" water—suction lift 8" Hg. Westinghouse turbine—steam pressure 575 lbs. G.—Superheat O F—exhaust pressure 15 lb. G—HP 300—RPM 4150—Type 20-V-R-G-B—steam chest pressure 900 lbs.—serial No. Pump 23706-23708-23707—Turbines 5A1034-51-50-44.

COCHRANE DEAERATOR

Maximum pressure 20 lbs.—220,000 lbs. per hour—1800 gallons storage volume.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
BALTIMORE 2, MD. Curtis 7-5050

DIESEL GENERATORS

3—Fairbanks Morse Engines and Alternators KVA 510, KVA 300, and KVA 170.

1—Winton Model 8/1580 direct connected to an E.M. Alternator 606 KVA.

All of the above 480 volts 3 phase 60 cycle. In excellent operating condition. Can be seen running.

Facilities available for re-installing if desired.

A-1 IRON AND METAL CO.
10010, South Alameda Street
South Gate, California
P.O. Box 511 Phone LOrain 6-6196
Contact: FREDRICK RILEY

COMPRESSOR DIRECTORY
World's Best Rebuilts

95 CFM 1500 psi (3) stage Chicago TCB-3
100 CFM 100-150 psi 6 x 7 Ingers. ES NL-Oilless
107 CFM 500 psi 7-3¼ x 8 Ingersoll ER-2
130 CFM 100 psi 7 x 7 Ingersoll ES NL-Oil-less
234 CFM 100 psi 9 x 9 Ingersoll ES-Worth. HB
268 CFM 500 psi 10-4¼ x 10 Ingersoll XOB
283 CFM 35 psi 10 x 7 Ingersoll ES
290 CFM 75 psi 10 x 9 Ingersoll ES
380 CFM 500 psi 11-5 x 13 Worth. HB-2
410 CFM 20 psi 12 x 7 Ingersoll ES-Gardner RX
628 CFM 100 psi 14 x 13 Chicago TB
1665 CFM 42 psi Inger. XRE-1 175 HP 3-60-550
1184 CFM Vacuum 22 x 9 Penn 7-AT
60-600 CFM Portable-Gas-Diesel
For Sale or Rent

American
AIR COMPRESSOR CORP
DELL AVE. & 47 th ST.
NORTH BERGEN, N.J.
Telephone UNion 5-4848

SPOT WELDING CONTROL

Complete with 150 KVA Transf. 550/440-12.22/6.05 Volts CR-7503 Thyratron Control—Timer—Relays—switches—etc.

J. L. HEMPHILL & CO.
1603 54th St., No. Bergen, N. J.

POWER EQUIPMENT

GEAR REDUCERS

7—Cleveland Worm, Size 400 RT, 19 HP @ 720 RPM, Ratio 20 to 1.
1—Link Belt Herringbone. 16.4 HP @ 1750 RPM, Ratio 225½ to 1.
1—W. A. Jones Planetary, 29 HP @ 1800 RPM, Ratio 48 to 1.
1—Link Belt Herringbone, 43.5 HP @ 1750 RPM, Ratio 30.33 to 1.

GEARMOTORS

8—15 HP, 3 Ph, 220/440 v, G.E. Parallel, 234 RPM.
1—20 HP, 3 Ph, 220 v, King Motorized Parallel, 185 RPM.
1—25 HP, 3 Ph, 440 v, Westinghouse, 230 RPM, TEFC Parallel.

VARIABLE SPEED DRIVES

7—7½ HP, 3 Ph, 220/440 v, Reeves Motodrive, Size 6000F-12, 1740 to 580 RPM.

ROTHMAN EQUIPMENT CO.
146 N. 3rd St. Phila. 6, Pa.
MArket 7-1963

CHEMICAL PLANT

Now dismantling for major producer and we offer good used equipment.

H. F. TURBINE

Westinghouse Model M-25 Steam power 400 KW 3 phase 500 KVA revolving field. A.C. generator 2100/4200 R.P.M. Non-condensing direct connected.

TRANSFORMERS 66.5 KVA

General Electric Type—H.T. 3 phase rated 100/180 cycle. High voltage 3445Y-low 63. 60 pieces each weighing 1640 pounds.

Miscellaneous Equipment

Various size tanks — motors — pumps — heaters—fans—monorail track-dryers—racks—buggies—containers—etc.

All Material Subject Prior Sale

STATE METALS & STEEL CO., INC.
903 Fidelity Building
Cleveland 14, Ohio
Phone:
Cleveland — SUperior 1-9559
Canton — GLendale 6-8225

SPECIALS

1—5000 KVA TURBO GENERATOR, Condensing, 400 PSI.

1—200 KW MG SET, 250 Volts DC, 2300/3/60.

1—2200 CFM, I.R. COMPRESSOR Type XPV, 110 PSI

1—1000 CFM, I.R. COMPRESSOR 173 HP Sync. drive.

BOILERS

2—300 HP KEWANEE, 125 PSI.

2—150 HP UNION WATER TUBE, 160 PSI.

1—250 HP B&W, 150 PSI.

2—4' x 135' STEEL STACKS.

1—70,000 LB. HEINE, 400 PSI.

HEAT & POWER CO., INC.
60 E. 42nd St., New York 17, N. Y.
Murray Hill 7-5280
(Machinery & Equipment Merchants)

A. C. GENERATORS — 60 CYCLE

KVA	Mfr.	Type	Volts	Speed
1000	Whse. syn cond		4000/2300	900
485	Allis Ch.	1 brg.	480	400
312	Gen. Elec.	ATI	240/480	900
275	G.E. 25 cycle	ATI	480	750
225	Gen. Elec	ATI	240/480	900
156	El. Machy		240/480	900
150	Whse.		2300/480	600
125	Whse.	1 phase	120/240	1200
94	Whse.	late	240/480	1200

ARTHUR WAGNER COMPANY 1906 1956 — 50th ANNIVERSARY

50 YEARS OF RELIABLE SERVICE TO INDUSTRY

A. C. MOTORS — 60 CYCLE

HP	Mfr.	Type	Volts	Speed
700	Allis Ch.	Sq. Cage	440	900
600	G.E.	Slipring	2300	600
500	G.E.	Sq. Cage	2200	3600
500	Whse.	Slipring	2200	450
500	G.E.	Sq. Cage	4000	1800
450	Allis Ch.	Synch.	480	400
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
350	G.E.	Sq. Cage	2200	1800
350	G.E.	Slipring	2200	514
300	G.E.	Sq. Cage	440	900
300	Whse.	Synch.	440	1200
300	Gen. Elec.	Slipring	220/440	1200
300	G.E.	Slipring	440	450
250	G.E.	Slipring	440	1800
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	Gen. Elec.	Synch.	220/440	450
250	G.E.	Synch.	220/440	720
250	L.A. (2)	Sq. Cage	220	1800
225	G.E.	Synch.	220/440	900
200	G.E. b.b.	Slipring	2200/440	720
200	Whse. (2)	Slipring	2200	514
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Gen. Elec.	Sq. Cage	220/440	720
200	Cr. Wh.	Sq. Cage	220/440	3600
200	Whse.	Sq. Cage	2200/440	900
200	E.M.	Synch.	220/440	1200
175	G.E. (2)	Synch.	220/440	720
150	El. Machy.	Synch.	220/440	360
150	G.E.	Slipring	2200/440	720
150	G.E. (4)	Slipring	2200/440	600
150	G.E. (2)	Sq. Cage	2200/440	720
125	Whse. TEFC	Sq. Cage	2200/440	720
125	Gen. Elec.	Slipring	440	600
125	G.E. TEFC	Sq. Cage	220/440	3600
125	Ideal	Slipring	4000/2200	900
100	Whse (2)	Sq. Cage	2200	900
125	G.E.	Slipring	220/440	450
		Slipring	220/440	720

BUY CERTIFIED REBUILT MOTORS AND GENERATORS

Save time and money with full guarantee

D. C. MOTORS

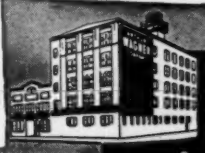
HP	Mfr.	Type	Volts	Speed
200	Reliance	1400-T	230	850
175	Cr. Wh.	151-R	230	500
150	Whse.	SK-184	230	850
100	Reliance	651-T	550	1000/1600
100	Reliance	651-T	230	575/1150
75	F. Morse b.b.	DH-140	115	1600
65	Cr. Wh.	CMC	230	575/1100
60	Allis Ch.	E-146	230	1150
50	G.E. (3)	CD-125	230	400/1200
40	Reliance b.b.	131-T	550	1750
35	Gen. Elec.	RF-14	230	250/1000
30	Imperial b.b.	D-69	230	400/1600

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V.
300	Gen. Elec.	2200/440 AC	260 DC
200	G.E. converter	220/440 AC	250 DC
200	El. Machy.*	2200/440 AC	250 DC
200	Whse.*	220/440 AC	55 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	Whse.*	220/440 AC	250 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	G.E.*	2200/440 AC	125 DC
100	Whse.	220/440 AC	250 DC
75	Cr. Wheeler	25 cycle	125 DC
75	Whse.	2200/440 AC	600 DC
60	Whse.	220/440 AC	250 DC
50	Gen. Elec.	220/440 AC	125 DC
50	Whse.	220/440 AC	250 DC
35	Whse.	220/440 AC	250 DC
25	Whse.	220/440 AC	125 DC

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
300	G.E. (2)	CY-275	260	1200
300	Reliance	1400-T	250	1200
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	650
100	Whse.	SK-180	250	900
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	Whse. b.b.	SK-163	125	1000
60	Allis Ch. (3)	E-146	250	1500
50	Gen. Elec.	CD-115	250	1200
25	Whse.	SK-93	125	1750



MO nroe 6-7409
1435 W. RANDOLPH ST.
CHICAGO 7, ILL.

CHECK WITH WAGNER FIRST . . .

THOUSANDS OF MACHINES IN STOCK UP TO 1000 H.P. - AC & DC.

SEND FOR THE LATEST WAGNER MOTOR-GRAM.

Arthur Wagner Co.

3000 KW MODERN POWER PLANT—COMPLETE

NEW 1949 ***LITTLE USED***

3000 KW Turbo generator, Allis Chalmers 3600 RPM 3/60/2300/4600 Volts 400# 600° FTT cond. 28" Vac.

50000 lbs/hr Boiler, Union Iron Works, 450 psi incl. stokers with traveling grates

WITH ALL AUXILIARIES

HUGO NEU CORPORATION

31 Nassau St. Tel: REctor 2-1334 New York 5, N. Y.

DIESEL ENGINES — POWER MACHINERY

100 KW to 1500 KW

Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

A. G. SCHOONMAKER COMPANY, INC.

MAIN OFFICE: Box 516, Sausalito, Calif. Sausalito 1600 **BRANCH: 50 Church St., N. Y. 7, N. Y. Digby 9-4350**

ATLANTIC TRANSFORMER COMPANY

REWINDING — REBUILDING
RECONDITIONING
ALL TYPES TRANSFORMERS

5143 N. 2nd ST., PHILA. 20, PA.

FOR SALE

Phase Changers — Dry and Wet Transformers—and All Auxiliary Equipment

We Buy, Sell or Rent

CONSULT US FIRST
FOR YOUR
TRANSFORMER NEEDS

Michigan 4-6963

Rebuilt
HEMPHILL Guaranteed EQUIPMENT

TRANSFORMERS 60 CYCLE

Qu	KVA	Make	Type	PH.	Voltages
2	750	G.E.	H	1	4600x120/240
1	750	G.E.	HT	3	4150Y-220/440
1	400	Pitts.	OISC	1	4150x240/480
2	333	West.	S	1	4150-240/480
2	300	G.E.	H	1	13200-110/220
3	200	G.E.	H KD	1	13800/12420/4600 240/480
3	200	G.E.	H	1	7800/15600-440/220
3	50	Pa.	OISC	1	2400/4160Y-240/480
4	50	G.E.	H	1	2400/4800-120/240
1	25	G.E.	Pyramol	1	7800/15600-440/220
1	25	Kuhlmann	H	3	440-110/220
3	25	Line Mat.	RW	1	2400/4160Y-120/240
6	15	Maloney	KL	1	2400/4160Y-120/240

SYNCHRONOUS MOTORS

QU	HP	Make	Speed	Type	Volts
1	1000	West.	360	Mill	2300/4150
1	500	Whse.	450	HR	440
1	350	Whse.	1800	CW	2300
1	300	KM	720	TEFC	2300
1	300	G.E.	600	ATI	220/440/2400
1	200	Whse.	600	ATI	240
3	200/100	Whse.	720/360	Syn.	4150
1	150	Whse.	900		220
1	150	G.E.	1800	TS	220
2	150	Allis	360		2200
1	125	G.E.	600	TS	2200
1	125	EM	900		4800
1	100	G.E.	900	TS	2200

SLIP RING MOTORS

QU	HP	Make	Speed	Type	Volts
1	500	G.E.	1200	M	2400/4150
1	150	Whse.	900	CW	2300
1	250	Whse.	600	CW	440
1	150	A.C.	1800	AY RW	2300
1	100	G.E.	1800	IM	220
1	75	G.E.	600	IM	440
1	200	Whse.	514	CW	440

SQUIRREL CAGE 60 CYCLE

Qu.	HP	Make	Type	Speed	Volts
1	150	G.E.	KT-562	600	440
1	100	West.	CS	1200	440
1	100	L Allis	RX, TEFC	1800	220/440
1	75	Ideal, 505	AT	1200	220/440

MOTOR GENERATOR SETS

QU	KW	Make	Speed	DC	AC
1	1000	Whse.	720	600	2300/4150 syn
1	1000	Whse.	720	275	2300/4150 syn
1	300	G.E.	1200	250	2300/4150 SR
1	150	C.W	600	125	220/440
1	100	Cr. Wh.	1200	250	Elect Mach. 550V Syn.
1	97	G.E.	1200	60	4150 Syn
1	75	G.E.	1800	250	220/440 SC
1	60	Whse.	1200	60	2200V
3	60	EM	1200	125	220
1	30	Whse.SK	1750	250	2300/4150 Syn
1	20	EM	1800	125	220 V
2	30	G.E.	1800	125	220/440 V

DC, 230 VOLT MOTORS

Qu	HP	Make	Speed	Type
2	150	C.W.	900	WP
1	125	G.E.	1700	BC
2	75	C.W.	900	WP
3	30	C.W.	700	CM
1	35	G.E.	860	R
1	25	Whse.	835	SK
1	30	G.E.	1650/1800	CDM85

FOR POWER
J.L. HEMPHILL & CO.
1603 54th STREET, NORTH BERGEN, N. J.

New & Used Diesel Engines, Generators. Take care of your Diesel Engine and it will help take care of you. Our many years of Power-Application experience may be of extra service to you. Please save this advertisement for your future reference. Thank you.

GLENMOORE DIESEL MFG. CO.
Glenmoore, Chester Co., Pa.
Phone Eagle 8-8115 day or night, closed Sunday.

FOR SALE

Complete Power Plant Equipment

1—Babcock & Wilcox Boiler, Type FV, 2-drum, bent tube, integral furnace boiler. Capacity 35,000 lbs. per hr. With steam atomized oil burner. Built 1950. Complete with all auxiliary equipment.

1—Permutit hot process, lime soda water softening system. Type BCD, 15,000 gals. per hr.

2—Boiler Feed Pumps. Buffalo Pump, two stage. Complete with drives and pressure regulator.

2—Return pumps. Worthington Simplex.

For further details write

CHESTER L. McMASTER
133 South Clinton Avenue
Rochester 4, New York

FOR SALE

A.C. & D.C. DIESEL GENERATOR SETS

A.C. SETS

(3) 200 KW G.M. model 8-268A—8 cyl.—air starting—6½ x 7—heat exchanger cooled—driving Westinghouse generator—200 KW 440/3/60—1200 RPM—with direct connected exciter and complete with panel board for generator, engine starting air compressor and starting air tanks. Reconditioned by U.S. Navy. Units in excellent condition. Price on request.

(1) 125 K.V.A. — 100 KW — 480/3/60 — 1200 RPM—radiator and fan belt assembly. All set up on pre-fab sub-base. Engine model 36A5½AE—160 HP—1200 RPM—#822541—engine mfg. by Fairbanks-Morse. Electric starting. GENERATOR: F.M. 100 KW—480/3/60—1200 RPM—Frame J.F. 20D—drip-proof construction—120 volt DC excitation. RECENTLY REMOVED FROM NAVY SHIP—good condition—$4750.00.

(40) NEW AND TEST RUN ONLY—BUILT 1953 20 KW—120/208—3 phase 60 cycle 1800 RPM 4-wire ball-bearing E.M. generators with voltage regulator. Excitation 0.75 KW—62.5 volts—12 amps. ENGINE: Sheppard Model 6D—4½ x 5—3 cyl.—radiator cooled—212.8 cu. inch displacement—self-contained fuel tank—steel I-Beam base—12 volt heavy duty starter. Full generator rating 5000 to 8000 ft. Above 8000 ft., loss of 3% per 1000 ft. BARGAIN PRICE $2095.00 EACH!

D.C. SETS

30 KW—120 volt DC—Sheppard model 12—6 cyl.—4 x 6—50 HP at 1200 RPM—continuous full load rating—radiator cooled—built to ABS & AIEE #45—class A insulation—electric starting. GENERATOR: 30 KW—120 volts DC—250 amps—shunt wound—40° rise.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
Baltimore 2, Md.—Lexington 9-1900

TURBO-GENERATORS

2500 KW G.E. Non-C. 3/60/2400/4160 V 3600 RPM 185 PSIG 30# BP

1500 KW West. Non-C. Extr. 3/60/2400 V 3600 RPM 450 PSIG 75# extr. 12# BP

1000 KW G.E. Cond. Extr. 3/60/480 V 3600 RPM 225 PSIG 20# extr.

Full line power equipment.

BREW, WOLTMAN & CO., INC.
50 Church St., New York 7, N. Y.

---

875 KVA DIESEL GENERATOR SET

Unused Chicago-Pneumatic 327 RPM G.E. Generator.

IN STOCK—BARGAIN

ALJON ELEC. DIESEL CO.
904 Pacific St., Bklyn 38, N.Y.

B & W BOILER

325 H.P. sectional header, cross drum, 160# pressure, with stoker. Installed new 1945.

Special price before removal

M. J. HUNT'S SONS
1620 N. Delaware Ave., Phila. 25, Pa.

FOR SALE

18 NEW TURBINES

4 horizontal, 14 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. DeROSE
2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

FOR SALE

2—Elliott (Ridgeway) steam engines rated at 250 HP, 325 RPM max. steam conditions—110 PSI inlet, 25 PSI outlet. Complete with accessories. Write for full specifications.

1—160 HP, 1200 RPM Climax R-61 Gasoline Engine. Like New.

For further details, write

Engineering Department
NEKOOSA-EDWARDS PAPER CO.
Port Edwards, Wisconsin

42" Belt Conveying Equipment—Like New
250 HP Scotch Marine Boiler—EXCELLENT
100 & 187 KVA Diesel Generating Plants
2—9x9 York Ice Machines w/motors
2—15 HP Gas Fired Boilers—100 lb.
1000 CFM Air Compressor w/300 HP mtr.
2—78x20' 150# HRT Boilers
200 HP, 160# WT Boiler

H. & P., 6719 Etzel, St. Louis 14, Mo.

FOR RATES OR INFORMATION About Classified Advertising,

Contact
The McGraw-Hill
Office Nearest you.

ATLANTA, 3
1321 Rhodes-Haverty Bldg. *WAlnut 5778*
W. LANIER

BOSTON, 16
350 Park Square *HUbard 2-7160*
H. J. SWEGER

CHICAGO, 11
520 No. Michigan Ave. *MOhawk 4-5800*
W. HIGGENS

CLEVELAND, 15
1510 Hanna Bldg. *SUperior 1-7000*
W. SULLIVAN

DALLAS, 2
Adolphus Tower Bldg., Main & Akard Sts. *PRospect 5064*
G. JONES

DETROIT, 26
856 Penobscot Bldg. *WOodward 2-1793*

LOS ANGELES, 17
1125 W. 6th St. *MAdison 6-9351*
H. L. KEELER

NEW YORK, 36
330 West 42 St. *LOngacre 4-3000*
S. HENRY — D. COSTER — R. LAWLESS
R. HATHAWAY

PHILADELPHIA, 3
17th & Sansom St. *RIttenhouse 6-0670*
H. BOZARTH — E. MINGLE

SAN FRANCISCO, 4
68 Post St. *DOuglas 2-4600*
R. C. ALCORN

GUARANTEED REBUILT POWER EQUIPMENT

SLIP RING MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2300 Volts or Higher)

HP	Make	Type	Speed
2000	*G.E.	MT	600
1250	*Al.-Ch.	ANY	1800
1250	*Westg.	CW	900
1000	*Westg.	CW	250
700	*Al-Ch.	ANY	1200
600	*G.E.	MT	450
500	Westg.	CW	350
500	Westg.	CW	900
400	Al-Ch.	3 brg.	450
300	*G.E.	IE-15A	1800
250	*G.E.	I-M	450
250	Westg.	HF-15H	600
200	G.E.	IK-15B	900
200	G.E.	IM	600
150	Cr. Wh.	50-R	1800
150	G.E.	MT-549	1800
150	*Wagner	RS-131	900
150	Westg.	CW	450
125	G.E.	IM-15A	600
100	G.E.	IM-13A	1800
100	G.E.	IM	600
100	G.E.	IM-15A	450
75	G.E.	MT-347	1200
75	G.E.	IM	1200
75	Al. Ch.	ARY-223C	1200
75	G.E.	MT-356	900
75	Al. Ch.	ANY-26F	900
75	Al. Ch.	ARY	720
75	G.E.	IM	600
60	*Westg.	CW-762C	900
50	*Al. Ch.	ARY-220-BS	1800
50	Westg.	CW	1800
50	*Al. Ch.	ARY	1200
50	Westg.	CW-636A	1200
50	Westg.	CW-658A	900
50	G.E.	MT-338	900

SLIP RING MOTORS

Crane & Hoist Service
3 Phase, 60 Cycle, 220 or 440 Volts

HP	Make	Type	Speed
80	G.E.	MTC-5552	600
75	Westg.	CI-756A	600
50	Westg.	MW-334	600
50	G.E.	HICTENV	600
35	G.E.	MTC-5538	600
20	Westg.	CI	1200
11	Westg.	CI-E464	900
10	P & H	BW-6	1800
5	P & H	BW-6	1200
5	N. West.	WRC	1200
3	G.E.	MTC-5944	900

PUNCH PRESS MOTORS

NEW—3/60/220-440 Volt
High Torque—Hi-Slip

HP	Make	Type	Speed
75	Fr.-Morse	QFZK	1065
60	Westg.	CS-752-C	1060
40	Reliance	AA-B-505	1635
30	L-Allis	OK-445	1080
25	Reliance	AA-C-504	1100
15	Imperial	F-444	1090

TURBINE GENERATORS
3750-2500-1563 KVA
Westinghouse & General Electric
400 lb. PSIG - 750 FTT, 3 Phase, 60 Cycle, 220 Volt. All with 2 pass surface condensers, exciter and control. Prints and detail available.
3750 KVA Westg. new in 1948

SQUIRREL CAGE MOTORS

3 Phase, 60 Cycle, 220 or 440 volts (*2300 volts or higher)

HP	Make	Type	Speed
1250	*Al. Ch.	ANX	3600
1200	*Al. Ch.	ARW	1200
750	*Westg.	CS	900
500	*Al. Ch.	ARW	3600
500	*G.E.	KT5608	900
500	G.E.	KT-424	450
450	*Al. Ch.	ARW	1800
400	G.E.	KT-424	360
300	*G.E.	K-6344Y	1200
300	G.E.	K-6353TEFC	720
250	Westg.	CS-TEFC	1800
250	G.E.	KT-550	1800
250	*L.-Allis	OEX-148	720
250	*G.E.	IK	600
250	G.E.	IK-17A	600
250	Westg.	CS-14	514
250	*Cr. Wh.	SC-68	900
200	*G.E.	FT-549Y	3600
200	*G.E.	IK-13B	1800
200	Al. Ch.	ARWWT	585
200	*Westg.	CS	600
200	G.E.	K-6352	514
150	G.E.	IE-13A	1800
150	G.E.	IE-13B	1200
150	*Al. Ch.	AN-30F	1200
150	U.S.	SC-587	1200
150	Westg.	CS-7728	1200
150	*Westg.	CS-8120STEC	1200
150	Westg.	CS-876C TEFC	900
150	*Westg.	CS	600
125	Westg.	CS-771 Sppf	1800
125	*Al. Ch.	AR	1800
125	Al. Ch.	AR-226 CS	1800
125	*Reliance	AA 6065	900
100	Westg.	CS6078 TEFC	3600

D.C. MOTORS

(*230 Volt)

HP	Make	Type	Speed
250	Westg.	SK-220	450 850
200	Westg.	SK-201	650
200	Cr. Wh.	CM	500
175	G.E.	ELC	750
100	G.E.	MPC	400/800
100	G.E.	RC-34	2500
100	G.E.	RC-19	575
100/150	G.E.	MCF	500/1000
50/120	G.E.	MCF	250/1000
50	Cr. Wh.	CMC	700/1100
50	G.E.	DLC-204	450
35	Westg.	SK-150	350/1000
30	Cr. Wh.	CCM-504	450
30/40	G.E.	CD-115	500/1500
25	G.E.	RC-32	800
25	Westg.	SK-133	575
20/25	Westg.	SK-151L	250/1000
20	Star	SB-10	1750

M.G. SETS

KW	Make	A.C.	D.C.
1250	Westg.	6600/4160	600
1000	G.E.	12,000	600
500	Westg.	2300	275
300	Westg.	2300/440	250
400	A.C.	2300	120/240
200	G.E.	2300	250/275
200	Westg.	2300/4000	250/275
200	Ridgeway	2300	250
170	G.E.	440	125
150	G.E.	2300	125/250
150	A.G.	2300	275
150	Westg.	2300	125/250
150	G.E.	440	275
150	G.E.	2300	250
100	Elec. Mach.	440	125
100	G.E.	440	125
90	G.E.	440	60

CHICAGO *Electric Co.*

1320 WEST CERMAK RD, CHICAGO 8, ILL.

BOILER FEED PUMPS

STEAM TURBINE DRIVEN

GPM	TFH	Stage	Mfg.
450	892	4	Worth. (2)
500	850	4	Worth.
200	1375	6	Ingersoll R. (2)
200	850	2	Weinman (2)
190	1320	4	De Laval
750	725	4	Worth. (2)

MOTOR DRIVEN

GPM	TFH	Stage	Mfg.
740	2250	5	Worth.
700	1550	6	Worth.
675	1100	5	LeCourtenay
500	1050	5	Worth. (3)
100	1150	5	Gould

UNDERWRITERS FIRE PUMP

GPM	TFH	Stage	Mfg.
1500	231	1 (motor driven)	Fairbanks
750	231	(gas. driven)	Allis Chal. (2)

MOTOR DRIVEN SAND PUMPS

American Manganese 10"
Allen-Shaffer-Hoff 14"

NASH HYTOR COMPRESSORS

(4) size #2, 850 R.P.M., 10# pressure, 240 C.F.M.; 860 R.P.M., 180 C.F.M., when used as a Vacuum Pump.

2—2800 Gal. cap. 100# steam press. hot water storage heaters, mfg. by Quaker City Iron Works. Good shape.

This is only a partial listing of pumps carried in stock. We have hundreds of other pumps, compressors, and power equipment. Don't ask us what we have, write and tell us what you want.

PHILADELPHIA TRANSFORMER CO.
Box 566 Dalton, Pa.

TRANSFORMERS

2—2000 Kva GE 13200-2400 Scott Tap
3—1667 Kva GE 13800-600
3—1000 Kva GE 13800-460
15— 50 Kva GE 33000-2400 New
120— 25 Kva GE 33000-2400 New

MOTORS • GENERATORS
TRANSFORMERS • SALES
REPAIRS • RENTALS

AMERICAN ELECTRIC SERVICE & MAINTENANCE CO.

Paramount & 2nd Sts., Springfield, Mass.
REpublic 2-2104; 2-2105

1—2500-KVA., WEST., 400#, 750° FTT., 28" VACUUM, GENERATOR, 3/60/2300-V.

Complete in every respect

1—1875-KVA., G.E., 440#, 750°FTT, 28" VACUUM, 3/60/2300-V.

Excellent Condition and Complete
Both Priced Right.

CHARLES WEAVER

19701 James Couzens Highway Detroit 35, Michigan

5000 KVA POWER PLANT

5000 KVA Westinghouse Condensing Turbine, 400 PSI, 3600 RPM 3/60/2400/4150 Generator, 6300 sq. ft. surface Condenser, 1000 HP Heine Water Tube Boiler 400 PSI, complete with water walls, superheater, pulverizers and all accessories,—on foundations.

WILL SELL INDIVIDUAL UNITS
-OR-
COMPLETE PLANT

HEAT & POWER CO., INC.

60 EAST 42nd STREET MURRAY HILL 7-5280 NEW YORK 17, N. Y.

3078 CFM INGER. RAND AIR COMPRESSOR

1—Modern Ingersoll Rand PRE2, Channel Valves, New 1942, Used Intermittently, 110 Lb. Pres. Air Compressor, Cylinders 30" & 18" x 21", directly driven by 500 hp, U.P.F. 3P, 60C, 440 V. Synchronous motor with exciter set and cubicle type push button starter. All fine shape—located Alabama.

DARIEN CORP., 60 E. 42nd St., N. Y. 17, N. Y.

New and Used Equipment Available for
POWER PLANTS, SUBSTATIONS, TRANSMISSION LINES AND CONSTRUCTION

Send for new list

EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE Two Rector St., New York 6, N. Y.

ADVERTISERS' INDEX

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

Air Preheater Corp. 191
Airetool Mfg. Co. 192
Alco Products, Inc. ..... *
Alken-Murray Corp. ..... *
Allen-Sherman-Hoff Co. ..... Second Cover
Allis-Chalmers Mfg. Co. 10-11, 58, 70
Allpax Company, Inc. 194
Aluminum Company of America 235
American Blower Corp. 16-17
American Engineering Co. ..... *
American Gilsonite Co. 201
American Pulverizer Co. 208
Ames Iron Works, Inc. ..... *
Anchor Packing Co. 177
Arkansas Fuel Oil Co. 49
Armstrong Cork Company 139
Armstrong Machine Works 137
Atomics International, Div. of North American Aviation, Inc. 38
Automatic Switch Co. ..... *

Babbitt Steam Specialty Co. ..... *
Babcock & Wilcox Co. 6-7, 149
Babcock & Wilcox Co. (Refractories Div.) 187
Babcock & Wilcox Co. (Tubular Products Div.) ..... *
Badger Mfg. Co. 197
Bailey Meter Co. 12-13
Baldwin-Hill Co. ..... *
Baltimore & Ohio Railroad ..... *
Beckman Instruments, Inc. 207
Bell & Gossett Co. ..... *
Bell & Zoller Coal Co. ..... *
Belmont Packing & Rubber Co. ..... *
Biddle Co., James G. 176
B-I-F Industries, Inc. ..... *
Bigelow Co. 206
Bingham Pump Co. 190
Black, Sivalls & Bryson, Inc. ..... *
Boiler Tube Co. of America 220
Bonney Forge & Tool Works 212
Bridgeport Brass Co. ..... *
Bros Boiler & Mfg. Co., Wm. ..... *
Brown Boveri Corp. ..... *
Buell Engineering Co. 180
Buffalo Forge Co. 106
Buffalo Pumps, Inc. 170
Bussmann Mfg. Co. ..... *
Byron Jackson Div., Borg-Warner Corp. ..... *

Canton Stoker Corp. ..... *
Carey Mfg. Co., Philip ..... Back Cover
Cash Co., A. W. ..... *
Catawissa Valve & Fittings Co. 189
Celanese Corp. of America (Chemical Div.) ..... *
Champion Rivet Co. ..... *
Chapman Valve Mfg. Co. 32
Chase Brass & Copper Co. 68
Chesapeake & Ohio Railway ..... *
Chesterton Co., A. W. ..... *
Chicago Pneumatic Tool Co. ..... *
Chicago-Wilcox Mfg. Co. ..... *
Cities Service Oil Co. 49
Clarage Fan Co. 213
Clark Bros. Co. 69
Clayton Mark & Co. ..... *
Cleaver-Brooks Co. (Boiler Div.) 179
Cleveland Fuel Equipment Co. ..... *
Cleveland Vibrator Co. 214
Cochrane Corporation ..... *
Coffin, Jr. Co., J. S. 202
Combustion Control Div., Electronics Corp. of America ..... *
Combustion Engineering, Inc. 46-47
Condenser Service & Engrg. Co. 172
Cooper-Bessemer Corp. 44
Copes-Vulcan Div., Blaw-Knox Company 14-15
Coppus Engineering Corp. ..... *
Corning Glass Works 214
Crane Company 155
Crane Packing Company ..... *
Crawford Fitting Co. 216
Cyclotherm Div., National-U. S. Radiator Corp. 210

Darling Valve & Mfg. Co. ..... *
Deady Chemical Co. ..... *
Dearborn Chemical Co. 65
DeLaval Separator Co. 153
DeLaval Steam Turbine Co. 2
Deming Company 233
Detroit Stoker Co. 173
Diamond Power Specialty Corp. 8-9, 59
Dodge Mfg. Corp. ..... *
Dow-Corning Corp. 230
Dowell, Inc. 167
Dravo Corporation 222

Eagle-Picher Co. 22-23
Edison, Inc., Thomas A. ..... *
Edward Valves, Inc. 39, 41
Electric Machinery Mfg. Co. 50
Electric Storage Battery Co., Exide Industrial Div. ..... *
Elgin Softener Corp. ..... *
Elliott Company 168, 226
Engineer Company ..... *
Enos Coal Mining Co. 234
Erico Products, Inc. 178
Erie City Iron Works 24-25
Ernst Water Column & Gage Co. 222, 242

Fairbanks Co. ..... *
Fisher Governor Co. 45
Flexitallic Gasket Co. 135
Foster Engineering Co. ..... *
Foster Wheeler Corp. 42-43
Foxboro Company ..... *
Frick Company ..... *
Friez Instrument Div., Bendix Aviation Corp. ..... *
Fuller Company ..... *

Garlock Packing Company 232
Gates Rubber Co. ..... *
General Blower Co. ..... *
General Electric Co. (Apparatus Dept.) 33-34-35-36, 147
General Precision Equip. Corp. ..... *
Goodrich Industrial Products Co., B. F. 252
Goulds Pumps, Inc. 228
Graver Water Conditioning Co. ..... *
Green Fire Brick Co., A. P. ..... *
Greene, Tweed & Co. ..... *
Grinnell Company ..... Third Cover
Gruendler Crusher & Pulverizer Co. ..... *
Gulf Oil Corp. ..... *
Gustin-Bacon Mfg. Co. ..... *

Hagan Corporation ..... *
Hall Laboratories ..... *
Halstead & Mitchell 238
Harbison-Walker Refractories Co. ..... *
Hays Corporation ..... *
Heyl & Patterson, Inc. 157
Hill Pump Valve Co. 242
Hilliard Corp. ..... *
Hills-McCanna Co. ..... *
Hoffman Specialty Mfg. Corp. ..... *
Hydro-Ash Corp. 222

I-T-E Circuit Breaker Co. (Switchgear Div.) ..... *
Illinois Water Treatment Co. 196
Infilco Inc. 74
Ingersoll-Rand Co. 175
International Nickel Co., Inc. ..... *

Jeffrey Mfg. Co. 40
Jenkins Bros. 144-145
Jerguson Gage & Valve Co. ..... *
Johns-Manville 151
Johnson Service Co. 161
Jones & Laughlin Steel Corp. ..... *
Joy Mfg. Company 61

Keasbey & Mattison Co. 219
Keeler Company, E. ..... *
Kennedy-Van Saun Mfg. & Engrg. Corp. 72-73
Kewanee Boiler Div. 199
Key Company ..... *
Kieley & Mueller 238
Kirk & Blum Mfg. Co. 174
Klinger, Ltd., Richard 198
Klockner-Humboldt-Deutz A.G. Koln 240
Koppers Co., Inc. (Aeromaster Fans) 204
Koppers Co., Inc. (Coupling Dept.) ..... *
Koppers Co., Inc. (Industrial Gas Cleaning Dept.) ..... *
Koppers Co., Inc. (Piston Ring & Seal Dept.) 56
Kuljian Corporation ..... *

Laclede Stoker Co. ..... *

Layne & Bowler Pump Co. ..... *
Leeds & Northrup Co. 143
Leslie Company ..... *
Link-Belt Company 1
Liquidometer Corp. ..... *
Lockett & Company, Ltd., A. M. 220
Lunkenheimer Company ..... *

Mahon Co., R. C. 51
Manning, Maxwell & Moore, Inc. 193
Marley Company 171
Marsh Instrument Co. 162
Mason-Neilan Regulator Co. ..... *
McGraw-Hill Book Co. 234
McKiernan-Terry Corp. 183
Mercoid Corp. ..... *
Midcontinent Tube Service, Inc. ..... *
Midwest Piping Co., Inc. ..... *
Mine Safety Appliances Co. ..... *
Minneapolis-Honeywell Regulator Co., Industrial Div. 26-27
Murray Iron Works Co. 141, 218
Murray Mfg. Co., D. J. ..... *

National Airoil Burner Co., Inc. 224
National Aluminate Corp. 29
National Coal Association 211
National Tube Div. ..... *
Niagara Blower Co. 192
Nicholson & Co., W. H. 67
Nordberg Mfg. Co. ..... *
Norris & Associates, R. S. ..... *
Norton Company ..... *

Ohio Brass Co. ..... *
Ohio Injector Co. ..... *
Okonite Co. 55
Olin Mathieson Chemical Corp., Industrial Chemicals Div. 205
Orr & Sembower, Inc. 185

Panellit, Inc. ..... *
Peabody Engineering Corp. 231
Peerless Pump Div. Food Machy. & Chemical Corp. 215
Pennsylvania Crusher Div. 165
Pennsylvania Flexible Metallic Tubing Co., Inc. ..... *
Permutit Company 227
Perolin Company, Inc. 37
Philadelphia Gear Works ..... *
Phoenix Mfg. Co. (Flange Div.) 238
Pittsburgh Piping & Equipment Co. 229
Powell Co., Wm. 57
Powers Regulator Co. 127
Pritchard & Co., J. F. 188, 189

Raybestos-Manhattan, Inc. Manhattan Rubber Div. ..... *
Raybestos-Manhattan, Inc. Packing Div. ..... *
Republic Flow Meters Co. 30-31
Republic Steel Corp. ..... *
Research-Cottrell, Inc. ..... *
Revere Copper & Brass, Inc. 159
Ric-Wil Incorporated 48
Ridge Tool Co. 200
Riley Stoker Corporation 104-105
Rohm & Haas Co. (Resinous Products Div.) ..... *
Ross Heat Exchanger Div. ..... *
Roto Div. of Elliott Co. ..... *

Sarco Company ..... *
Scam Instrument Corp. 196
Schaub Engrg. Co., Fred H. 221
Scovill Mfg. Co. ..... *
Sinclair Refining Co. 66
Smith Company, S. Morgan 223
Smith Corporation, A. O. ..... *
Socony Mobil Oil Co., Inc. ..... *
Solar Aircraft Co. 217
Spence Engineering Co. 209
Standard Oil Co. of Indiana 133
Standard Steel Spring Div., Rockwell Spring & Axle Co. 186
Stephens-Adamson Mfg. Co. 52
Stickle Steam Specialties Co. ..... *
Stillwater Clay Products Co., Stillwater Conduit Div. ..... *
Stock Equipment Co. ..... *
Stone & Webster Engrg. Co. ..... *
Strong, Carlisle & Hammond Co. ..... *
Sturtevant Mill Co. ..... *
Sumo Pumps, Inc. ..... *

Taylor Instrument Co's ..... *
Taylor & Company, W. A. ..... *
Terry Steam Turbine Co. 60
Texas Company 4
Titusville Iron Works Co. Div. of Struthers Wells Corp. ..... *
Todd Shipyards Corp., Products Div. ..... *
Toledo Pipe Threading Machine Co. ..... *
Tube Turns, Inc. ..... *

Union Asbestos & Rubber Co. ..... *
Union Iron Works 225
U.S. Electrical Motors, Inc. 64
United States Gasket Co. ..... *
United States Rubber Co. (Mechanical Goods Div.) 28
United States Steel Corp. 63
Universal Atlas Cement Co. ..... *

Vapor Heating Corp. ..... *
Viking Pump Co. 186
Vogt Machine Co., Henry 62

W-S Fittings Div., H. K. Porter Company, Inc. ..... *
W-K-M Manufacturing Co., Inc. ..... *
Wallace & Tiernan Inc. ..... *
Walworth Company 203
Warren Steam Pump Co., Inc. ..... *
Western Chemical Co. 184
Western Precipitation Corp. ..... *
Westinghouse Electric Corp. (Sturtevant Div.) ..... *
Wheeler Mfg. Co., C. H. ..... *
Where to Buy 242
Wickes Boiler Co. 20-21
Wiedeke Co., Gustav ..... *
Wilson, Inc., Thomas C. 240
Wing Mfg. Co., L. J. 195
Worthington Corp. 53-54, 181
Wright-Austin Co. 182

Yarnall-Waring Company 18-19, 129

Zallea Bros. 169

Professional Services **242**

CLASSIFIED ADVERTISING

F. J. Eberle, Business Manager

EMPLOYMENT OPPORTUNITIES. 243, 244
EDUCATIONAL 244
EQUIPMENT (Used or Surplus New) For Sale 244-249
WANTED Equipment 244, 245

ADVERTISERS INDEX

A-I Iron & Metal Co. 246
Aljon Electric Diesel Co. 248
American Air Compressor Corp. 246
American Electric Service & Maintenance 249
American & Foreign Power Co. 244
Arabian American Oil Co. 243
Atlantic Transformer Co. 247
Belyea Co., Inc. 246
Benson-Wilimizig Inc. 245
Boston Metals Co., Inc. 246, 248
Braun & Co., C. F. 243
Brew-Woltman & Co., Inc. 248
Broome County Technical Institute 244
Chicago Electric Co. 249
Darien Corp. 249
DeRose, G. M. 248
Ebasco Service Inc. 249
Electric Service Co., Inc. 245
General Electric Co. 244
Glenmoore Diesel Mfg. Co. 248
Globe Trading Co. 244
Hall & Co., Stephen 246
H & P Machinery Co. 248
Heat & Power Co., Inc. 247, 249
Hemphill & Co., Inc. 246, 248
Hunt's Sons, N. J. 248
Kentucky Color & Chemical Co. 244
McMasters, Chester L. 248
Mississippi Valley Equipment Co. 245
Monsanto Chemical Co. 244
Nekoosa-Edwards Paper Co. 248
Neu Corp., Hugo 245, 247
Oberman, Paul 244
Ohio Power Machinery Co. 244
Philadelphia Transformer Co. 249
Rothman Eqpt. Co. 246
Schoonmaker Co., Inc., A. G. 247
State Metals & Steel Co., Inc. 247
Turner, W. D. 244
Universal Power Eng. Co. 244
Wagner Co., Arthur 247
Walker & Collins 244
Weaver, Charles 245, 249

B.F.Goodrich

Shakedown by three rubber toughs

A typical example of B. F. Goodrich improvement in rubber

COAL gets packed in those freight cars so tight it won't come loose when the hopper at the bottom is opened. Men used to crawl in the car and using pick and shovel, break it loose. Sometimes it took two men eight hours to unload a car and more important, it was dangerous.

Then a machine was developed that's put on the side of the car and shakes the material loose. The shaking is done by three B. F. Goodrich Grommet V belts driving a shaft that's out of round and off balance. Many kinds of V belts were tried but broke from the teeth-chattering vibrations.

But the B. F. Goodrich V belt, with two husky grommets imbedded deep in rubber, can take and recover from shock with no ill effects. Now, push a button and the cars are unloaded in ten minutes.

Today's B. F. Goodrich V belts are the result of constant improvement, better processes for prestretching cords, for improving cord adhesion, for reducing internal heat and friction. In these and many other ways B. F. Goodrich belt engineers have successfully attacked the common causes of V belt failure, and in many cases, more than doubled belt service life.

Let your B. F. Goodrich distributor show you how this longer belt life, this ability to stand harder use, can reduce your V belt costs per year, make other savings in operating and maintenance costs. *B. F. Goodrich Industrial Products Company, Dept. M-677, Akron 18, Ohio.*

Grommet—T. M. The B. F. Goodrich Co.

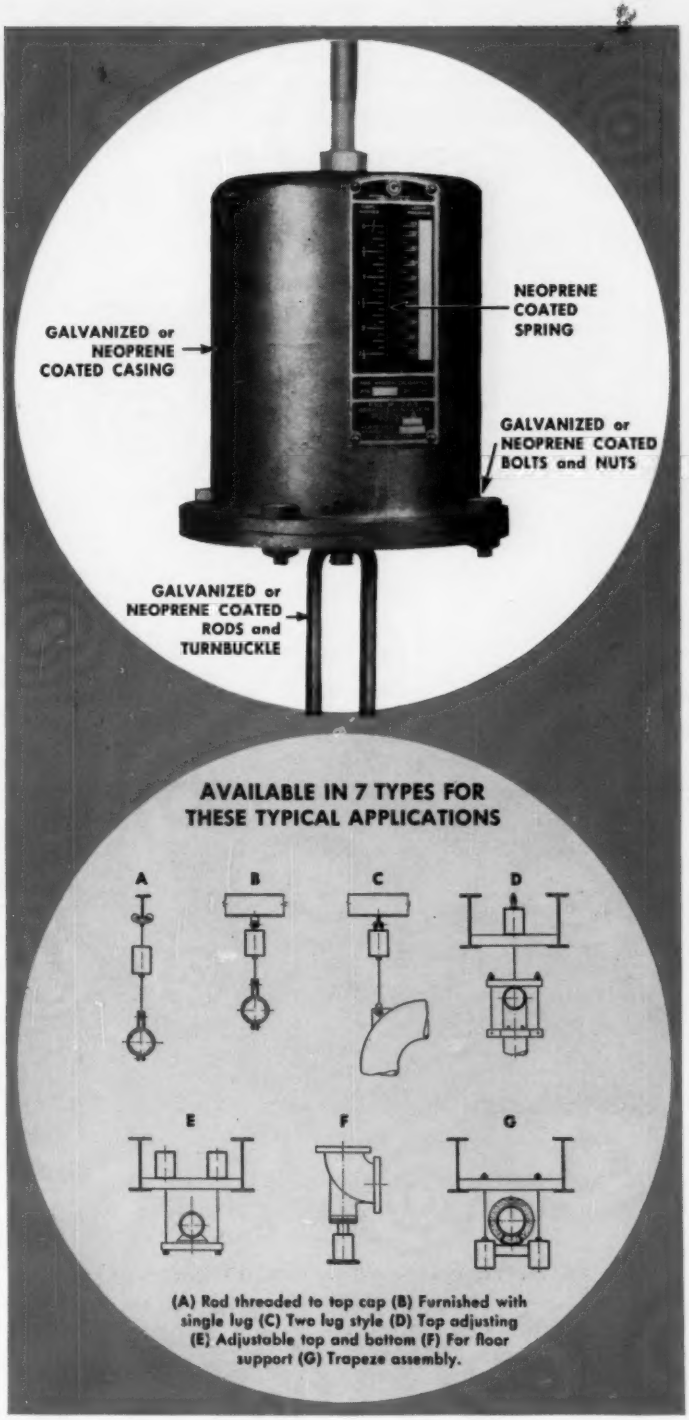
B.F.Goodrich

INDUSTRIAL PRODUCTS

NEW

weather-resistant, corrosion-resistant

GRINNELL VARIABLE SPRING HANGERS...


GALVANIZED or NEOPRENE COATED CASING
NEOPRENE COATED SPRING
GALVANIZED or NEOPRENE COATED BOLTS and NUTS
GALVANIZED or NEOPRENE COATED RODS and TURNBUCKLE
AVAILABLE IN 7 TYPES FOR THESE TYPICAL APPLICATIONS
A
B
C
D
E
F
G
(A) Rod threaded to top cap (B) Furnished with single lug (C) Two lug style (D) Top adjusting (E) Adjustable top and bottom (F) For floor support (G) Trapeze assembly.

Another Grinnell First!

Grinnell pre-engineered spring hangers are now offered in two new lines to meet the need for spring hangers in installations subject to highly corrosive industrial conditions and to severe weather exposure.

These hangers are the result of extensive experimentation with various coatings for Grinnell's standard pre-engineered spring hangers. In addition to providing flexibility in pipe suspension, they provide versatility of application through their corrosion-resistant characteristics. They are . . .

1. Neoprene coated — for highly corrosive conditions such as those found in chemical plants and refineries. *All* parts of the hanger are neoprene coated to protect the base metal from a wide range of corrosives. The flex life of the spring is unaffected by the neoprene . . . the coating resists cracking or flaking over a wide temperature range.

2. Galvanized — for outdoor installations where weather conditions are severe. All parts of the hanger are galvanized except the spring, which is neoprene coated to avoid alteration of temper, hydrogen embrittlement and decreased flex-life of the spring — usual hazards to springs from the galvanizing process.

Along with the obvious advantages of such corrosion and weather-resistant characteristics, consider these features . . .

- Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes.
- Precompression* assures operation of spring within its proper working range, as well as saving valuable erection time. Reduced over-all height saves space.
- 18 sizes available from stock for load ranges from 53 lbs. to 12,000 lbs.
- Available in 3 spring lengths for travel ranges of 1¼, 2½, and 5 inches.
- Installation is simplified by integral load scale and travel indicators.

Precompression is a patented feature.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

For this WIDE temperature range

ONLY ONE INSULATION provides lasting EFFICIENCY

Carey Alltemp

■ Operation at high temperatures actually increases the efficiency of ALLTEMP. Heating lowers the conductivity of this super-efficient *universal* pipe and block insulation. Installed in place, it will not crumble or crack under severe service conditions. Non-brittle ALLTEMP cuts true and square for tight joints. Here—*in one formulation*—is the performance you want for *all* temperatures up to 1600° F. For cost-saving facts and the Carey ALLTEMP Specification Folder, mail coupon below.

Carey

industrial insulation

THE PHILIP CAREY MFG. COMPANY

Better Products for Industry Since 1873

Lockland, Cincinnati 15, Ohio

In Canada: The Philip Carey Co., Ltd., Montreal 3, P. Q.

Carey-approved contract units in major trading areas. Consult your nearest Carey District Office or your telephone directory.

THE PHILIP CAREY MFG. COMPANY,
Lockland, Cincinnati 15, Ohio, Dept. P-7

Send ALLTEMP Folder of specifications and installation details.
☐ Have your Industrial Sales Engineer call.

NAME.....

COMPANY.....

ADDRESS.....

CITY..... ZONE..... STATE.....